

03:21:42 1 on the 2020 census results?

03:21:44 2 A. Yes.

03:21:44 3 Q. And have you evaluated the map
03:21:47 4 prepared by the Gressman Math Science
03:21:50 5 Petitioners?

03:21:51 6 A. I have, yes.

03:21:51 7 Q. And on the screen is a map, do
03:21:57 8 you recognize it?

03:21:59 9 A. Yes.

03:21:59 10 Q. And what is it?

03:22:01 11 A. This is the map proposed by the
03:22:01 12 mathematician and scientist
03:22:09 13 petitioners.

03:22:09 14 Q. Okay.

03:22:10 15 And you are here and have been
03:22:11 16 stipulated as an expert in
03:22:13 17 redistricting and data analysis. Are
03:22:14 18 you an expert on Pennsylvania
03:22:16 19 geography itself?

03:22:17 20 A. No, I'm not.

03:22:18 21 Q. And did you actually draw this
03:22:19 22 map?

03:22:20 23 A. No, I did not.

03:22:21 24 Q. Could you just briefly explain
03:22:22 25 for the Court your understanding of

03:22:24 1 how the map was prepared?

03:22:28 2 A. So my understanding is that
03:22:29 3 sort of principles of computational
03:22:32 4 redistricting were applied, so the
03:22:34 5 idea was that there were sort of a ---
03:22:37 6 you know, there are several
03:22:38 7 traditional districting criteria and
03:22:40 8 so this was formulated as a sort of
03:22:42 9 multi objective optimization problem,
03:22:45 10 and so the computer generated sort of
03:22:48 11 many plans intended to optimize for
03:22:50 12 those traditional criteria.

03:22:52 13 Q. And did you prepare some
03:22:53 14 reports in this case?

03:22:54 15 A. I did, yes.

03:22:55 16 Q. And do you have those sitting
03:22:56 17 goes in front of you, Doctor DeFord?

03:22:59 18 A. Yes, I do.

03:22:59 19 Q. And what analysis did the
03:23:07 20 Gressman Math and Science Petitioners
03:23:07 21 ask you to perform with respect to
03:23:09 22 their map?

03:23:10 23 A. So I was asked to analyze the
03:23:12 24 map in terms of sort of traditional
03:23:25 25 districting criteria, criteria drawn

03:23:25 1 from the --- traditional districting
03:23:28 2 criteria as well as criteria derived
03:23:32 3 from the Pennsylvania Commonwealth
03:23:34 4 Constitution, and sort of responsive
03:23:37 5 to the orders in the League of Women's
03:23:43 6 Voters case.

03:23:43 7 Q. Okay.

03:23:43 8 And how many criteria did you
03:23:44 9 evaluate?

03:23:45 10 A. Six.

03:23:45 11 Q. Could you list those for the
03:23:47 12 Court, please?

03:23:49 13 A. So population balance,
03:23:51 14 contiguity, compactness, the
03:23:55 15 preservation of municipal boundaries,
03:23:57 16 the existence and number of minority
03:24:06 17 election opportunity districts and
03:24:06 18 partisan fairness.

03:24:06 19 Q. And I think you mentioned
03:24:09 20 municipal boundaries. Were there any
03:24:10 21 other boundaries that you evaluated
03:24:12 22 the map for?

03:24:13 23 A. Yes, I --- yes, I evaluated the
03:24:15 24 six types of boundaries that are
03:24:22 25 explicitly listed in the Constitution.

03:24:22 1 Q. Okay.

03:24:22 2 And can you start by
03:24:23 3 summarizing your conclusions about how
03:24:25 4 the Gressman Math and Science map
03:24:27 5 performed on all of these criteria
03:24:30 6 together?

03:24:31 7 A. So my report concludes that the
03:24:35 8 mathematicians and scientist map
03:24:37 9 performs very well on these criteria
03:24:40 10 and use the best possible population
03:24:44 11 balance. It sort of undoes remarkably
03:24:48 12 well in terms of partisan fairness, it
03:24:51 13 preserves sort of the many --- sort of
03:24:58 14 a high degree, the counties, municipal
03:25:02 15 boundaries and wards in the state, and
03:25:12 16 also it constructs three voting age
03:25:12 17 minority/majority districts.

03:25:13 18 Q. So let's start with population
03:25:13 19 balance. Did you evaluate how the
03:25:14 20 math and science map performs with
03:25:14 21 respect to population balance?

03:25:15 22 A. Yes, I did.

03:25:16 23 Q. And how did it perform?

03:25:21 24 A. So I just use the best possible
03:25:25 25 population balance of a deviation of

03:25:25 1 one person between the largest
03:25:27 2 district and the smallest district in
03:25:29 3 the plan.

03:25:30 4 Q. And did you evaluate how the
03:25:32 5 other maps submitted to the Court
03:25:35 6 perform with respect to population
03:25:36 7 balance?

03:25:36 8 A. Yes, I did.

03:25:36 9 Q. Did any of those maps have more
03:25:39 10 than a one person deviation?

03:25:41 11 A. Yes.

03:25:41 12 Q. Which ones?

03:25:46 13 A. So two of the maps the Carter
03:25:46 14 map and the map submitted by the House
03:25:50 15 Democratic Caucus had at least one
03:25:53 16 district with sort of one person over
03:25:55 17 the ideal value, and so a maximum
03:25:58 18 population deviation of two people
03:26:00 19 between the largest district and the
03:26:01 20 smallest district.

03:26:02 21 Q. And in your experience
03:26:04 22 evaluating maps, is it standard for a
03:26:07 23 congressional map to be drawn with
03:26:08 24 more than one person deviation?

03:26:10 25 A. No.

03:26:11 1 Q. Let's move on to discussing
03:26:20 2 political boundary subdivisions.
03:26:21 3 Can you describe your understanding of
03:26:22 4 the Pennsylvania requirements
03:26:22 5 regarding boundary preservation?

03:26:25 6 A. So the requirement, at least in
03:26:25 7 the Constitution, with respect to
03:26:25 8 state legislative districts uses very
03:26:31 9 strong language about preserving those
03:26:36 10 boundaries. And in particular with
03:26:39 11 respect to counties, cities,
03:26:43 12 incorporated towns, boroughs and
03:26:46 13 townships and wards.

03:26:46 14 Q. And did you evaluate the math
03:26:48 15 and science map and the other maps
03:26:51 16 submitted to the Court to see how they
03:26:55 17 performed with respect to each of
03:26:56 18 those boundary preservations?

03:26:57 19 A. Yes, I did.

03:26:59 20 Q. Okay.

03:26:59 21 And how many metrics did you
03:27:00 22 use to evaluate how those maps
03:27:02 23 performed with respect to boundary
03:27:04 24 preservation?

03:27:06 25 A. Four.

03:27:06 1 Q. Could you list them for the
03:27:08 2 Court, please?

03:27:09 3 A. Sure. So we computed the total
03:27:12 4 number of splits in the counties ---
03:27:15 5 sorry, split units, the number of
03:27:17 6 split units beyond those required for
03:27:19 7 population reasons, the number of
03:27:24 8 cases, which I think we referred to as
03:27:25 9 segments earlier today, as well as the
03:27:27 10 number of segments beyond those
03:27:33 11 required for population or to preserve
03:27:36 12 another larger boundary.

03:27:36 13 Q. Okay.

03:27:37 14 And starting with counties,
03:27:38 15 what did you conclude about how the
03:27:40 16 math and science map performed with
03:27:43 17 respect to maintaining political
03:27:44 18 boundaries of counties?

03:27:45 19 A. It did well on that measure.

03:27:49 20 Q. And did you evaluate the other
03:27:51 21 maps as well for that same metric?

03:27:53 22 A. I did, yes.

03:27:54 23 Q. And let's turn to your
03:28:00 24 responsive brief, to the top of page
03:28:03 25 five, to Table 2.

03:28:36 1 All right. Do you see this
03:28:36 2 table?

03:28:37 3 A. Yes.

03:28:37 4 Q. Okay.

03:28:37 5 And can you please summarize
03:28:40 6 for the Court what this table shows?

03:28:42 7 A. So this table shows three of
03:28:45 8 those measures that I just mentioned,
03:28:46 9 so the top row is just the number of
03:28:48 10 counties that were split by the
03:28:51 11 various plans submitted by the
03:28:52 12 parties. So this is just the number
03:28:54 13 of counties that intersected at least
03:29:01 14 two districts. The second row shows
03:29:02 15 the number of sort of what we call
03:29:04 16 non-intact counties, which are those
03:29:05 17 split more times than is required by
03:29:07 18 their population total. And then, the
03:29:09 19 final row shows the number of pieces
03:29:12 20 with the number of times the districts
03:29:15 21 intersect those counties, again
03:29:18 22 accounting for pieces that must exist
03:29:20 23 because of population balance.

03:29:22 24 Q. Okay.

03:29:23 25 Can you explain to the Court

03:29:24 1 what you mean by the number of county
03:29:25 2 pieces beyond those required for
03:29:27 3 population?

03:29:28 4 A. Sure. So for example,
03:29:33 5 Philadelphia County has a population
03:29:34 6 that's equal to about 2.1
03:29:37 7 Congressional Districts, and so in a
03:29:38 8 population balance plan there must be
03:29:40 9 at least three districts that touch
03:29:44 10 that plan --- or that county.

03:29:45 11 Similarly Allegheny and
03:29:47 12 Montgomery Counties each have more
03:29:48 13 population than a single district, and
03:29:51 14 so have to be split into at least two
03:29:53 15 pieces, and so this measure accounts
03:29:55 16 for that by not sort of counting it
03:30:01 17 against the map for splitting those
03:30:03 18 units, as required by population
03:30:05 19 reasons.

03:30:05 20 Q. And what are the types of
03:30:07 21 municipalities moving on from counties
03:30:10 22 that the Pennsylvania Constitution
03:30:11 23 says should not be split unless
03:30:14 24 absolutely necessary?

03:30:16 25 A. So it specifically mentions

03:30:16 1 cities, incorporated towns, boroughs
03:30:19 2 and townships.

03:30:22 3 Q. Okay.

03:30:22 4 And how did the math and
03:30:24 5 science map perform in terms of
03:30:26 6 municipality splits?

03:30:27 7 A. So --- sorry --- it performed
03:30:32 8 very well in that measure. So it
03:30:32 9 split cities, sort of the minimum
03:30:36 10 amount possible. That's also true for
03:30:38 11 the sole incorporated town. It split
03:30:41 12 very few boroughs and following the
03:30:42 13 example of the 2018 plan, only split
03:30:45 14 boroughs in places where the borough
03:30:45 15 itself overlapped with a county
03:30:55 16 boundary and split fewer than the one
03:30:55 17 percent of the townships in the state.

03:30:57 18 Q. And what I put on the screen is
03:30:59 19 page six of your rebuttal report,
03:31:01 20 contains Table 3. Could you summarize
03:31:04 21 for the Court how the Gressman Math
03:31:08 22 and Science map, which is denoted as
03:31:10 23 GMS here, performs with respect to
03:31:13 24 municipality splits?

03:31:15 25 A. So across those four listed

03:31:18 1 types of municipalities in terms of
03:31:21 2 total splits, the mathematicians and
03:31:24 3 scientist plan splits fewer than any
03:31:27 4 of the other maps, and in particular
03:31:29 5 sort of achieves the lowest possible
03:31:31 6 value for cities. So Philadelphia,
03:31:33 7 the --- you know, city and county are
03:31:37 8 co-terminus, and it has a population
03:31:39 9 larger than two districts, so it has
03:31:40 10 to be split, but no other cities are
03:31:42 11 split in this plan. And so overall in
03:31:45 12 terms of the total number of splits
03:31:51 13 it's very small.

03:31:51 14 Q. Okay.

03:31:51 15 And did you also analyze the
03:31:52 16 performance of the max in terms of
03:31:56 17 ward splits?

03:31:57 18 A. I did, yes.

03:31:57 19 Q. And how did the math and
03:31:59 20 science map perform in terms of ward
03:32:03 21 splits?

03:32:03 22 A. The math and sciences plan
03:32:07 23 splits only 15 wards, which is the
03:32:10 24 smallest out of any of the plans
03:32:12 25 proposed by parties.

03:32:14 1 Q. Okay.

03:32:23 2 And did you then analyze the
03:32:25 3 total number of split political
03:32:29 4 subdivisions in each of the maps?

03:32:31 5 A. I did, yes.

03:32:31 6 Q. Okay.

03:32:35 7 And is that what is reflected
03:32:36 8 in Table 6 of your report?

03:32:39 9 A. That's correct.

03:32:40 10 Q. Okay.

03:32:41 11 So there's going to be a number
03:32:43 12 of witnesses testifying about
03:32:44 13 political subdivision splits in the
03:32:46 14 different maps, what, in your opinion,
03:32:50 15 are the most salient metrics that will
03:32:52 16 help the Court understand how the maps
03:32:55 17 perform relative to each other in
03:32:57 18 terms of protecting and preserving
03:32:59 19 political subdivisions?

03:33:01 20 A. So I think it's very helpful to
03:33:04 21 sort of look at the sort of sum of the
03:33:06 22 splits across the six classes that are
03:33:08 23 specifically listed in the
03:33:10 24 Constitution. Particularly because
03:33:11 25 you can see the potential for, you

03:33:12 1 know, perhaps trade-offs between
03:33:14 2 those, splitting fewer counties with
03:33:16 3 being forced to split, more
03:33:18 4 municipalities in order to achieve
03:33:20 5 population balance. And so looking at
03:33:23 6 sort of all those splits together,
03:33:24 7 which is done in the bottom row of
03:33:28 8 this table allows you to sort of
03:33:29 9 account for those trade-offs.

03:33:31 10 Q. And just for the record, are
03:33:32 11 you referring to Table 6 of your
03:33:34 12 rebuttal report?

03:33:35 13 A. Yes, I am.

03:33:37 14 Q. Okay.

03:33:41 15 And can I ask you to explain to
03:33:44 16 the Court what is reflected in Table 7
03:33:47 17 of your rebuttal report?

03:33:49 18 A. So in addition to looking at
03:33:51 19 just the number of splits of the
03:33:52 20 units, as mentioned before it's also
03:33:55 21 helpful to look at the number of
03:33:56 22 pieces to make sure that it's not the
03:33:59 23 case --- for example, you know, a
03:34:00 24 single unit is getting split a whole
03:34:02 25 bunch of times, but only counting once

03:34:05 1 under the splits measurement, and so
03:34:05 2 this table reports on those values
03:34:08 3 across, again, the sort of six listed
03:34:11 4 types of political boundaries, and
03:34:15 5 again, computes sort of the total
03:34:15 6 number of pieces beyond those required
03:34:19 7 before.

03:34:19 8 Q. And how does the Gressman Math
03:34:21 9 and Science map perform with respect
03:34:25 10 to pieces relative to the other maps?

03:34:27 11 A. Very well. So it's tied for
03:34:33 12 first on this measure.

03:34:33 13 Q. Okay.

03:34:34 14 Can you --- let's talk about
03:34:35 15 compactness. Did you evaluate how the
03:34:38 16 Gressman Math and Science map performs
03:34:41 17 relative to the other maps with
03:34:43 18 respect to compactness?

03:34:44 19 A. Yes, I did.

03:34:44 20 Q. Okay.

03:34:44 21 And were you here earlier when
03:34:47 22 Doctor Rodden testified about his
03:34:49 23 metrics for compactness?

03:34:51 24 A. Yes, I was.

03:34:51 25 Q. And did you agree with his

03:34:53 1 definitions as to those metrics?

03:34:55 2 A. Yes.

03:34:56 3 Q. And did you also evaluate the
03:35:00 4 different maps using multiple
03:35:03 5 different metrics to evaluate
03:35:05 6 compactness?

03:35:05 7 A. Yes, that's correct. Like
03:35:07 8 Doctor Rodden --- sorry.

03:35:07 9 Q. Why did you do that?

03:35:12 10 A. Yes. So I think it's --- it's
03:35:12 11 important to note that single measure
03:35:14 12 of compactness captures everything
03:35:14 13 that is sort of meant by that, that
03:35:19 14 word in terms of geographic regularity
03:35:20 15 of the districts, and so it's
03:35:20 16 important to look at a variety of
03:35:23 17 measures.

03:35:23 18 Q. Okay.

03:35:24 19 And based on the measures that
03:35:25 20 you used, how did the Gressman Math
03:35:28 21 and Science map perform in terms of
03:35:30 22 compactness?

03:35:31 23 A. So it performs well as sort of
03:35:33 24 across the measures.

03:35:35 25 Q. Okay.

03:35:36 1 And if you know, how did the
03:35:37 2 Gressman Math Science map compare to
03:35:44 3 the compactness scores of the map that
03:35:44 4 was adopted by the Supreme Court of
03:35:47 5 Pennsylvania in 2018?

03:35:48 6 A. So on three of the four metrics
03:35:48 7 that I computed, it outperforms the
03:35:51 8 2018 map, so that's the Polsby-Popper
03:35:54 9 score, the mean Convex Hull and the
03:35:59 10 cut edges measure. And it's sort of
03:36:02 11 got a slightly smaller value to a .03
03:36:03 12 on the mean REOC score.

03:36:06 13 Q. Could you explain to the Court
03:36:09 14 how compactness relates to the other
03:36:11 15 redistricting criteria, for example,
03:36:14 16 political boundary subdivisions?

03:36:17 17 A. So in redistricting there's
03:36:19 18 lots of examples of potential
03:36:21 19 trade-offs between the metrics and
03:36:23 20 between the criteria. And in a
03:36:25 21 situation like this one where many of
03:36:28 22 the plans are preserving lots of
03:36:30 23 political boundaries, the compactness
03:36:33 24 measures that are measuring sort of
03:36:35 25 the external perimeters of those

03:36:38 1 boundaries are to a large extent sort
03:36:39 2 of controlled by the municipal
03:36:41 3 boundaries themselves, because they
03:36:42 4 perform the outer boundaries of the
03:36:46 5 districts. And so given that, there
03:36:47 6 can be some tension between these,
03:36:50 7 depending on the shapes of the
03:36:51 8 municipal boundaries that are
03:36:54 9 preserved.

03:37:04 10 Q. So what I put on the screen is
03:37:15 11 from your opening report on page 21,
03:37:16 12 it's Figure 6. What is this image?

03:37:17 13 A. So this image is showing
03:37:19 14 Allegheny County, which I mentioned
03:37:21 15 has to be touched by at least two
03:37:23 16 districts in all of the plans, and
03:37:25 17 also has the boundary of Pittsburgh,
03:37:28 18 which is sort of the center of
03:37:29 19 Allegheny County and also the second
03:37:30 20 largest city in the state highlighted.
03:37:33 21 And the overlays here, the colors
03:37:36 22 represent two of the maps and sort of
03:37:38 23 how they interact with Allegheny
03:37:38 24 County.

03:37:40 25 So the left shows the

03:37:41 1 mathematician and scientist plan,
03:37:48 2 which preserves Pittsburgh, and in
03:37:48 3 particular with respect to compactness
03:37:48 4 then, also preserves all of its sort
03:37:51 5 of legally boundary components. The
03:37:56 6 right panel shows the map proposed by
03:38:00 7 the Governor overlaid here that splits
03:38:00 8 Pittsburgh and has a much smoother
03:38:03 9 boundary in that region.

03:38:05 10 Q. Okay.

03:38:06 11 So how were the maps that are
03:38:07 12 before the Court that keep Pittsburgh
03:38:09 13 whole affected in their compactness
03:38:12 14 score by keeping Pittsburgh whole?

03:38:15 15 A. So if you look at, for example,
03:38:16 16 the Polsby-Popper scores of the two
03:38:21 17 districts that intersect Allegheny
03:38:23 18 County across all of the plans there's
03:38:25 19 a large difference between those
03:38:27 20 scores on plans that keep Pittsburgh
03:38:32 21 whole and hence sort of include those
03:38:34 22 boundary components that are a little
03:38:36 23 irregular and plans that split
03:38:39 24 Pittsburgh and have higher
03:38:45 25 Polsby-Popper scores.

03:38:46 1 Q. And notwithstanding that the
03:38:46 2 mathematicians and scientists keep
03:38:47 3 Pittsburgh whole, what is your bottom
03:38:48 4 line conclusion about their map's
03:38:51 5 compactness scores?

03:38:52 6 A. That it is compact and that the
03:38:53 7 scores themselves are quite good.

03:38:56 8 Q. Okay.

03:38:57 9 Now, at the outset of your
03:38:58 10 testimony, I think, one of the six
03:38:59 11 factors you evaluated you listed
03:39:02 12 partisan fairness.

03:39:03 13 Can you explain how you define
03:39:06 14 partisan fairness from a mathematical
03:39:10 15 perspective?

03:39:10 16 A. So the measures of partisan
03:39:12 17 fairness that I looked at are rooted
03:39:15 18 in trying to model and understand ways
03:39:17 19 in which a particular plan treats
03:39:20 20 voters from the two major parties, and
03:39:20 21 particularly trying to show that they
03:39:20 22 are treated the same, that they're
03:39:29 23 treated fairly.

03:39:29 24 Q. Okay.

03:39:30 25 And is there any one metric

03:39:32 1 that allows you to fully assess a map
03:39:35 2 partisan fairness?

03:39:37 3 A. No.

03:39:37 4 Q. So what kinds of metrics did
03:39:39 5 you use to assess the map's respective
03:39:42 6 partisan fairness?

03:39:43 7 A. So I took two and broad
03:39:46 8 perspectives. One was to analyze just
03:39:48 9 sort of majoritarian translation or
03:39:56 10 responsiveness so the ability of
03:39:57 11 voters from each party to translate a
03:39:58 12 majorities of the votes to majorities
03:39:59 13 of the seats. I also looked at
03:40:02 14 expected measures of partisanship
03:40:02 15 symmetry, which, again, you're
03:40:08 16 supposed to measure at the extent to
03:40:09 17 which a plan is treating the voters
03:40:09 18 from each party fairly.

03:40:09 19 Q. Okay.

03:40:12 20 And how did you begin that
03:40:14 21 analysis?

03:40:14 22 A. So to start with, we needed
03:40:16 23 some election data to evaluate and so
03:40:19 24 I selected statewide general
03:40:23 25 elections.

03:40:24 1 Q. And why did you select

03:40:28 2 statewide general elections?

03:40:30 3 A. So as we're considering various
03:40:31 4 different types of boundaries, we need
03:40:33 5 to have sort of a way to compare them
03:40:36 6 effectively, and so because everybody
03:40:38 7 was voting for the same candidates in
03:40:41 8 those elections, using those statewide
03:40:44 9 results allows us to sort of
03:40:45 10 investigate what happens as we vary
03:40:49 11 the boundaries.

03:40:49 12 Q. Okay.

03:40:49 13 And can you explain to the
03:40:51 14 Court which elections you used?

03:40:53 15 A. Yes. So I looked at in general
03:40:56 16 elections over the last decades, so
03:40:59 17 starting in 2012 and going up through
03:41:01 18 2020, I took the Presidential
03:41:05 19 Gubernatorial, senatorial races as
03:41:11 20 well as the State Auditor, State
03:41:12 21 Attorney General and one State Supreme
03:41:15 22 Court race from 2017.

03:41:15 23 Q. Why did you include the State
03:41:17 24 Supreme Court race from 2017 in your
03:41:20 25 approach?

03:41:21 1 A. So one of the reasons for
03:41:22 2 looking at lots of different elections
03:41:24 3 is to get a sense for how the voters
03:41:27 4 actually sort of act in different
03:41:29 5 situations, and across that set of
03:41:31 6 elections, not including the State
03:41:34 7 Supreme Court race, you have a more
03:41:38 8 Democratic favoring elections than
03:41:40 9 Republican ones. And the Republican
03:41:42 10 wins themselves are pretty close, so
03:41:44 11 they're all fairly narrow wins. The
03:41:47 12 State Supreme Court race was one that
03:41:48 13 had sort of a larger Republican wins
03:41:51 14 with over five percent margin that was
03:41:53 15 used to investigate the effects of
03:41:58 16 just sort of different distribution of
03:41:58 17 voters than the other elections.

03:42:00 18 Q. Okay.

03:42:00 19 And so you take the results of
03:42:01 20 these 18 statewide elections and what
03:42:04 21 do you do with the data?

03:42:06 22 A. So you have this data, the
03:42:09 23 level of sort of voting districts
03:42:11 24 where it's initially aggregated, and
03:42:12 25 then you sort of add that up within

03:42:15 1 the district boundaries themselves to
03:42:16 2 get within each of those districts,
03:42:19 3 how many people voted for each of the
03:42:23 4 two major party candidates in each
03:42:24 5 election.

03:42:25 6 Q. Okay.

03:42:25 7 And so how do you know that
03:42:27 8 because people in a particular area
03:42:29 9 voted Democrat for Attorney General or
03:42:32 10 for Governor that they would also vote
03:42:36 11 Democrat in a congressional election?

03:42:40 12 A. So you definitely don't
03:42:41 13 perfectly. It's not a case that this
03:42:42 14 is some sort of magic crystal ball
03:42:46 15 that lets you see in the future, but
03:42:46 16 this is a good representation of that,
03:42:46 17 so this is a commonly used method in
03:42:52 18 the field, it's one that's been, you
03:42:55 19 know, validated in various ways. And
03:42:57 20 like I said, allows us to do this
03:42:59 21 comparison in using the actual votes
03:43:01 22 of actual Pennsylvania residents where
03:43:08 23 they live to try to understand how
03:43:08 24 they're distributed around the state.

03:43:08 25 Q. Okay.

03:43:08 1 And so you take the collection
03:43:10 2 of data from these 18 statewide
03:43:12 3 elections and you map it onto the map
03:43:15 4 that you are assessing.

03:43:16 5 Is that correct?

03:43:17 6 A. Yes, that is correct.

03:43:18 7 Q. Okay.

03:43:18 8 And what are you looking for?

03:43:21 9 A. So to start with, you know, the
03:43:23 10 first thing that we're going to
03:43:25 11 compute is just the sort of the
03:43:27 12 percentage of Democratic voters in
03:43:30 13 each of those regions --- or each of
03:43:32 14 those districts and so that's going to
03:43:33 15 get us a set of 17 percentages per
03:43:37 16 election, one for each district. And
03:43:37 17 then from those, we'll say the ones
03:43:40 18 where the Democratic party got more
03:43:42 19 than 50 percent of the votes, you
03:43:42 20 know, we're going to count those as
03:43:47 21 wins for the Democratic party. Ones
03:43:48 22 that got less than 50 percent of the
03:43:50 23 votes, we're going to count those as
03:43:52 24 wins for the Republican party, and so
03:43:54 25 then for each election we can measure

03:43:58 1 the number of seats in a specific plan
03:44:03 2 that would have been won by each
03:44:03 3 party.

03:44:03 4 Q. And what would you expect to
03:44:05 5 see from a map that treats voters from
03:44:08 6 each political party fairly?

03:44:09 7 A. So the first criterion and sort
03:44:09 8 of the starting place for all of the
9 measures of partisan fairness is this
10 idea of majority representation that
11 even small majorities, hopefully, in
12 terms of the votes should be able to
13 converted into majorities of the seats
14 of the representation.

15 Q. Okay.

03:44:33 16 And did you use this approach
03:44:35 17 to analyze the Gressman Math and
03:44:40 18 Science map and the other maps for
03:44:44 19 their partisan fairness?

03:44:45 20 A. Yes.

03:44:45 21 Q. And how did the Gressman Math
03:44:45 22 and Science map perform when you used
03:44:47 23 this approach to measure for partisan
03:44:53 24 fairness?

03:44:53 25 A. So of the 18 elections that I

03:44:55 1 considered, the Gressman Math and
03:44:56 2 Science's map achieved a majoritarian
03:44:59 3 result in 15 of the 18 elections,
03:45:02 4 which is quite a good score,
03:45:03 5 particularly because there are several
03:45:05 6 very close elections in the data set,
03:45:08 7 particularly in recent years, and the
03:45:12 8 map performs effectively at allowing
03:45:14 9 majorities of voters to sort of
03:45:16 10 convert that into a majority of the
03:45:20 11 seats.

03:45:20 12 Q. And what happened in the three
03:45:22 13 elections where a majority of the
03:45:23 14 votes didn't translate into a majority
03:45:26 15 of the seats?

03:45:27 16 A. So there were two cases the
03:45:29 17 auditors race in 2012 and the
03:45:32 18 auditor's race in 2016, or the
03:45:35 19 statewide candidate, the one was a
03:45:38 20 Democrat, but that under the Gressman
03:45:39 21 Math and Sciences plan, the
03:45:41 22 Republicans would have won a majority
03:45:44 23 of the Districts. And there was also
03:45:45 24 one plan or one election, the senate
03:45:50 25 election in 2016 where the Republican

03:45:52 1 candidate won the statewide vote, but
03:45:55 2 the Democrats would have gotten a
03:45:58 3 majority of the seats under the
03:45:59 4 Gressman map.

03:46:01 5 Q. And how did the other maps you
03:46:03 6 evaluated perform using this approach?

03:46:09 7 A. So the Gressman map was tied
03:46:11 8 for the best in terms of the total
03:46:12 9 number of outcomes of 15 out of 18,
03:46:15 10 and also, you know, had this sort of
03:46:17 11 good sign that it treated the parties
03:46:18 12 as equally as possible in deviations
03:46:21 13 from that, so having some were
03:46:24 14 deviated for the Republican, some were
03:46:26 15 deviated for the Democrats, and that
03:46:29 16 was not a case across all of the maps.
03:46:31 17 So in particular, I think, four of the
03:46:36 18 plans had cases where all of the
03:46:38 19 deviations favored one party.

03:46:41 20 Q. Which of the maps performed the
03:46:43 21 worst in terms of partisan fairness
03:46:48 22 when using this approach to test for
03:46:52 23 partisan fairness?

03:46:52 24 A. So under this approach, those
03:46:56 25 were the two Reschenthaler maps, each

03:46:57 1 of which had six elections where the
03:47:01 2 Democratic candidate won the statewide
03:47:01 3 majority, but the sort of Republican
03:47:05 4 party would have won a majority of the
03:47:06 5 seats.

03:47:06 6 Q. And how did the House
03:47:08 7 Republicans map perform using this
03:47:11 8 approach?

03:47:11 9 A. So it was a similar approach to
03:47:15 10 the Reschenthaler maps, in that it ---
03:47:15 11 there were five elections where it
03:47:17 12 failed to convert majorities from the
03:47:20 13 Democratic party and no elections
03:47:25 14 where a Republican candidate won the
03:47:27 15 statewide race, but the Democrats
03:47:30 16 would have gotten the majority of the
03:47:33 17 seats.

03:47:33 18 Q. At the beginning of your
03:47:34 19 testimony you mentioned --- or on
03:47:35 20 partisan fairness you mentioned
03:47:35 21 partisan symmetry. Can you explain to
03:47:35 22 the Court what you mean by partisan
03:47:42 23 symmetry?

03:47:42 24 A. Yeah. So the idea here sort of
03:47:43 25 extends the original idea of

03:47:47 1 majoritarianism to try to evaluate how
03:47:50 2 the plans treat voters from each party
03:47:54 3 symmetrically, perhaps under sort of
03:47:55 4 shifts of the underlying voting data.

03:47:58 5 Q. What was the first technique
03:48:00 6 that you used to evaluate the partisan
03:48:03 7 symmetry of the different maps?

03:48:08 8 A. As with the previous expert I
03:48:10 9 evaluated the difference between the
03:48:13 10 mean and median score.

03:48:14 11 Q. Okay.

03:48:25 12 I'm displaying on the screen,
03:48:27 13 from your rebuttal report, on page 13,
03:48:30 14 Figure 1, and I think it might be
03:48:31 15 helpful to just walk through it for
03:48:33 16 the Court.

03:48:33 17 So what do - what do the dots
03:48:35 18 on this figure represent?

03:48:40 19 A. So each row of dots is
03:48:43 20 associated to one of the proposed
03:48:48 21 plans by the parties and then each
03:48:51 22 individual dot corresponds to that
03:48:51 23 mean median difference for one of the
03:48:53 24 18 elections. So there's 18 dots in
03:48:55 25 each row here. And the new median

03:48:59 1 score is signed, so here positive
03:49:01 2 values that are colored blue indicate
03:49:04 3 elections under that particular map
03:49:06 4 that would have had favorable values
03:49:08 5 for the Democratic party under the
03:49:14 6 score, whereas the red values indicate
03:49:16 7 elections that would have had a
03:49:16 8 favorable value for the Republican
03:49:20 9 party for the score.

03:49:20 10 Q. And what does the purple line
03:49:24 11 down the middle represent?

03:49:24 12 A. So the purple line is centered
03:49:25 13 at zero, which is the ideal value
03:49:27 14 under this measure, so the idea being
03:49:32 15 that there's sort of a transition in
03:49:33 16 sort of majority of the representation
03:49:38 17 right at zero.

03:49:43 18 Q. Okay.

03:49:43 19 And so what does that show you
03:49:44 20 about the partisan fairness of the
03:49:46 21 various maps that are under
03:49:48 22 consideration?

03:49:49 23 A. So there's two things we're
03:49:50 24 looking for here. The first is that
03:49:53 25 because we have this ideal value of

03:49:55 1 zero, and it's sort of the best score
03:49:57 2 you can achieve on this metric, we
03:49:59 3 want to see points that are close to
03:50:01 4 zero and being representing sort of
03:50:03 5 results that are more fair. And so
03:50:05 6 the idea there is that values on
03:50:09 7 either side that are closer to zero
03:50:13 8 treat --- are better at treating the
03:50:14 9 voters from each party equally.

03:50:16 10 So in corresponding the values
03:50:18 11 that are further away on either side
03:50:20 12 correspond to sort of less fair
03:50:20 13 elections under this metric.

03:50:25 14 The other thing we sort of
03:50:26 15 expect to see in a reasonably fair
03:50:28 16 plan is values on both sides of zero,
03:50:31 17 sort of representing that under some
03:50:34 18 of those elections that favored one
03:50:34 19 party on other elections favoring
03:50:40 20 another party.

03:50:40 21 Q. Okay.

03:50:40 22 And how did the Gressman Math
03:50:42 23 and Science map perform in your
03:50:43 24 evaluation of mean median scores?

03:50:46 25 A. So it performs very well. So

03:50:48 1 absolutely as well as in relation to
03:50:48 2 the other parties, so it has some
03:50:51 3 values, some elections that favor both
03:50:56 4 parties, and it has sort of the small
03:50:58 5 range of values from the smallest
03:51:01 6 value that it observes across these
03:51:03 7 elections up to the largest ones.

03:51:05 8 Q. And which maps performed the
03:51:07 9 most poorly on mean median score?

03:51:10 10 A. So there's, you know, a couple
03:51:12 11 of ways to measure this, as I said.
03:51:14 12 The first one is we can see that the
03:51:17 13 two Reschenthaler maps and the House
03:51:25 14 Republicans map over all of the
03:51:25 15 elections have Republican favoring
03:51:26 16 values, so there weren't sort of
03:51:26 17 differences between the two there.
03:51:27 18 They also had fairly large ranges,
03:51:31 19 which are reported in the next table,
03:51:32 20 I think, in the report.

03:51:34 21 Q. Okay.

03:51:35 22 What other techniques did you
03:51:36 23 use to assess partisan symmetry?

03:51:39 24 A. The final technique --- and
03:51:42 25 like the mean median score, this was

03:51:44 1 one that was sort of referenced
03:51:45 2 explicitly in the discussion the
03:51:48 3 League of Women Voters was the
03:51:48 4 efficiency gap measure.

03:51:52 5 Q. Okay.

03:51:52 6 What does the efficiency gap
03:51:56 7 measure?

03:51:56 8 A. So the efficiency gap is
03:51:58 9 designed to sort of capture the
03:51:58 10 difference in the number of wasted
03:52:03 11 votes between the two parties in a
03:52:05 12 given election.

03:52:06 13 Q. Can you explain to the Court,
03:52:08 14 please, what it means for votes to be
03:52:10 15 wasted?

03:52:11 16 A. So it's defined in the sort of
03:52:14 17 original paper that introduced the
03:52:16 18 efficiency gap. There's two ways that
03:52:17 19 a vote can count as wasted in a
03:52:17 20 particular election. So the first is
03:52:21 21 it counts any vote that goes towards a
03:52:23 22 candidate that lost in a particular
03:52:23 23 district as wasted, because it didn't
03:52:27 24 go for a winning candidate. The other
03:52:28 25 way a vote can be wasted if it's for a

03:52:31 1 winning candidate, somebody who won
03:52:35 2 the district but was beyond those that
03:52:35 3 were actually needed to win a
03:52:39 4 district.

03:52:39 5 Q. And if there are a lot of
03:52:43 6 wasted votes for one party but not the
03:52:48 7 other, what does that tell you about a
03:52:49 8 map's partisan fairness?

03:52:49 9 A. So that's a sign or at least a
03:52:49 10 measure that's capturing something
03:52:49 11 about unequal treatment that voters
03:52:54 12 from parties are sort of wasting votes
03:52:57 13 in different quantities.

03:52:59 14 Q. I'm now displaying on the
03:53:01 15 screen, from your rebuttal report,
03:53:03 16 Figure 2, which appears on page 14.
03:53:06 17 Again, can you just explain for the
03:53:07 18 Court what the dots represent on this
03:53:09 19 figure?

03:53:10 20 A. So here the dots represent the
03:53:12 21 efficiency gap scores. Again, the
03:53:14 22 rows correspond to the proposed plans
03:53:16 23 by the parties and each dot
03:53:16 24 corresponds to the efficiency gap
03:53:22 25 score for that proposed plan in one of

03:53:26 1 the 18 elections.

03:53:26 2 Q. And what does the line down the
03:53:28 3 middle on this chart represent?

03:53:33 4 A. So again, that line is posted
03:53:33 5 zero, which is the ideal value under
03:53:34 6 this measure that would have sort of
03:53:35 7 exactly the same number of wasted
03:53:36 8 votes for both parties.

03:53:38 9 Q. Okay.

03:53:39 10 And what does this figure
03:53:41 11 demonstrate about the relative
03:53:42 12 partisan fairness of the maps under
03:53:45 13 consideration?

03:53:46 14 A. So the same two criteria to try
03:53:50 15 to understand how the maps are
03:53:54 16 performing here are true from the mean
03:53:54 17 median score. So we'd like to see in
03:53:56 18 maps that are fair, lots of values
03:53:58 19 that are closer and closer around zero
03:54:00 20 as well as sort of a small overall
03:54:05 21 range of values that are observed
03:54:05 22 across the maps.

03:54:06 23 Q. Okay.

03:54:06 24 And how did the math and
03:54:08 25 science map perform with respect to

03:54:10 1 its efficiency gap score?

03:54:12 2 A. So as with the median score it
03:54:16 3 performs very well. It has values for
03:54:18 4 both parties as a sort of small range
03:54:20 5 of overall values, and the values
03:54:22 6 themselves are sort of clustered near
03:54:25 7 zero, particularly relative to the
03:54:30 8 other collection of maps.

03:54:30 9 Q. Okay.

03:54:31 10 Are you aware that several
03:54:33 11 experts have evaluated maps using a
03:54:35 12 website called Plan Score?

03:54:37 13 A. Yes, I am.

03:54:39 14 Q. And can you tell the Court what
03:54:41 15 Plan Score is?

03:54:42 16 A. Plan Score is a website that's
03:54:47 17 designed to make it easy to evaluate,
03:54:49 18 at least some aspects of the expected
03:54:50 19 partisan performance of districting
03:54:52 20 plans. So you upload a shape file to
03:54:54 21 the website, it has a collection of
03:54:55 22 historical data as well as sort of a
03:54:58 23 very clever statistical model that it
03:55:01 24 uses to evaluate a collection of
03:55:07 25 partisan symmetry measures for that

03:55:09 1 proposed plan.

03:55:09 2 Q. And after reviewing the other
03:55:09 3 expert reports, did you do anything to
03:55:11 4 test their conclusions about how maps
03:55:17 5 performed on Plan Score?

03:55:19 6 A. Yes, I did.

03:55:19 7 Q. And can you tell the Court what
03:55:21 8 you did?

03:55:22 9 A. So I took each of the shape
03:55:23 10 files for the proposed maps of the
03:55:27 11 parties and put them up on Plan Score
03:55:31 12 to get it sort of report evaluations
03:55:34 13 of the four person metrics that it
03:55:35 14 reports.

03:55:35 15 Q. And what did that show you?

03:55:37 16 A. So across all of the four
03:55:41 17 metrics and across all of the plans,
03:55:44 18 the mathematicians and scientists map
03:55:50 19 performed the best with exactly one
03:55:50 20 exception. So the efficiency gap
03:55:52 21 measure of the House Democratic map
03:55:55 22 was --- had a score of 1.2 compared to
03:55:58 23 a score of 1.4 and mathematicians and
03:56:01 24 scientists plan, but for every other
03:56:02 25 plan and on every other measure, the

03:56:02 1 mathematician and scientist plan got
03:56:13 2 the best score.

03:56:13 3 Q. Okay.

03:56:13 4 So if you were evaluating all
03:56:16 5 of these metrics together together,
03:56:16 6 what bottom line conclusions did you
03:56:16 7 draw about the partisan fairness of
03:56:20 8 the math and science map?

03:56:20 9 A. So that the math and sciences
03:56:24 10 map performs remarkably well on these
03:56:26 11 measures, and in particular its
03:56:29 12 ability to translate even small
03:56:32 13 majorities for both parties into sort
03:56:32 14 of electoral majorities is, you know,
03:56:34 15 a very good sign about its fairness.
03:56:38 16 You know, the plan score results
03:56:38 17 themselves are very strong and
03:56:40 18 demonstrate that, you know, the map
03:56:40 19 under a broad collection of symmetry
03:56:40 20 measures performs very close to the
03:56:50 21 ideal values and better than the other
03:56:50 22 proposed maps, and the same is true
03:56:55 23 for the specific details in my report.

03:56:57 24 Q. And so taking all of the
03:56:58 25 metrics together is there any map that

03:57:01 1 performs better than the Gressman Math
03:57:06 2 Science map with respect to partisan
03:57:08 3 fairness?

03:57:08 4 A. No, there's not.

03:57:09 5 Q. Did you perform an ensemble
03:57:09 6 analysis to test the map's partisan
03:57:17 7 fairness?

03:57:17 8 A. No, I did not.

03:57:17 9 Q. Why not?

03:57:18 10 A. So I didn't think it was
03:57:20 11 necessary here. You know, ensemble
03:57:25 12 analyses are great for determining
03:57:28 13 facts about, you know, expected values
03:57:28 14 of distributions based on modeling
03:57:29 15 decisions over the state, but what we
03:57:32 16 have here, and particularly in my
03:57:34 17 initial analysis of the mathematician
03:57:36 18 and scientist map, it achieves, you
03:57:41 19 know, very good values on the absolute
03:57:43 20 scorers. And given they're
03:57:43 21 interpretations as actual measurements
03:57:45 22 of partisan fairness, the fact that
03:57:47 23 they achieve those values doesn't need
03:57:50 24 to be excused by trying to understand
03:57:56 25 a different distribution.

03:57:56 1 Q. Did you review an expert report
03:57:59 2 prepared by Professor Barber?

03:58:00 3 A. Yes, I did.

03:58:01 4 Q. And did you evaluate his
03:58:07 5 ensemble analysis?

03:58:07 6 A. To the extent it was possible
03:58:10 7 from the information provided in the
03:58:13 8 report.

03:58:13 9 Q. Do you agree with his
03:58:14 10 conclusion about what his ensemble
03:58:17 11 analysis shows?

03:58:18 12 A. No, I do not.

03:58:18 13 Q. So for the reason that I just
03:58:21 14 mentioned that, you know, looking at
03:58:23 15 this plan you can see that it achieves
03:58:27 16 excellent scores on the partisan
03:58:29 17 fairness measures. And so the fact
03:58:34 18 that you can draw lots of plans that
03:58:37 19 get poor scores on those measures,
03:58:39 20 doesn't mean that a plan that gets
03:58:41 21 better scores should be, you know,
03:58:47 22 discarded.

03:58:47 23 Q. Okay.

03:58:48 24 Did you evaluate how the
03:58:49 25 different maps performed with respect

03:58:51 1 to pairing of incumbents?

03:58:57 2 A. Yes, I did.

03:58:58 3 Q. And why did you evaluate that?

03:58:59 4 A. So this is, again, one of these
03:59:01 5 features of sort of complexity of
03:59:04 6 redistricting analysis that it's
03:59:04 7 certainly possible that by choosing
03:59:07 8 which incumbents are paired in which
03:59:10 9 districts and which party they come
03:59:12 10 from, that there can be, you know,
03:59:14 11 unequally distributed harms from those
03:59:22 12 pairings in the proposed plans.

03:59:22 13 Q. Okay.

03:59:22 14 And how did the Gressman Math
03:59:28 15 and Science map perform with respect
03:59:28 16 to the pairing of incumbents?

03:59:29 17 A. So it does the best possible,
03:59:30 18 so because Pennsylvania is moving from
03:59:32 19 18 to 17 districts, there has to be at
03:59:36 20 least one repairing in each of the
03:59:40 21 plans. But there are two current
03:59:41 22 representatives who are not running
03:59:42 23 for re-election this year, and one of
03:59:44 24 those is one of the two in a paired
03:59:47 25 district in the mathematicians and

03:59:48 1 scientist plan.

03:59:49 2 Q. And how did that compare to the
03:59:51 3 other maps that you looked at?

03:59:53 4 A. So all of the other maps had at
03:59:56 5 least one district to where there are
03:59:57 6 two current representatives who are
04:00:00 7 seeking re-election that are paired.

04:00:06 8 Q. And was this, in your view, a
04:00:09 9 potential sign of partisan unfairness
04:00:11 10 in any of the maps?

04:00:12 11 A. There are some imbalances in
04:00:12 12 terms of the numbers of candidates
04:00:15 13 from each party that are paired in
04:00:17 14 some of the maps.

04:00:18 15 Q. Can you provide the Court with
04:00:19 16 some examples?

04:00:20 17 A. Yeah, sure. Sorry. So for
04:00:22 18 example, in the Senate Democratic's
04:00:26 19 map two among the sort of paired
04:00:30 20 candidates there are three Republicans
04:00:31 21 and one Democrat. A similar thing is
04:00:33 22 the true for the Rechenhalter first
04:00:37 23 map, but in reverse so there's three
04:00:38 24 Democrats and one Republican paired
04:00:41 25 there.

04:00:41 1 Q. Okay.

04:00:44 2 Let's talk now about minority
04:00:45 3 electoral opportunity. Why did you
04:00:49 4 evaluate that?

04:00:50 5 A. So I evaluated that to, you
04:00:54 6 know, understand sort of compliance
04:00:57 7 with the Voting Rights Act as well as
04:00:59 8 to sort of understand it is a
04:01:01 9 traditional redistricting principle.

04:01:06 10 Q. Okay.

04:01:06 11 In Pennsylvania what is the
04:01:10 12 minority citizen voting age population
04:01:16 13 as of the latest census?

04:01:17 14 A. It's about one-fifth or 20
04:01:18 15 percent.

04:01:18 16 Q. So in a 17 district map, how
04:01:21 17 many reasonably compact majority,
04:01:26 18 minority electoral --- minority
04:01:28 19 opportunity districts would you expect
04:01:30 20 to see?

04:01:31 21 A. So you know .2 times 17 is a
04:01:34 22 little over 3, so about 3.

04:01:36 23 Q. And your report discusses an
04:01:39 24 analysis that you performed of
04:01:41 25 minority electoral opportunity in the

04:01:45 1 math and science map, what did you
04:01:47 2 conclude about its creation of
04:01:49 3 effective minority districts?

04:01:51 4 A. I concluded that the three
04:01:55 5 districts in the plan, which are
04:01:57 6 Districts 2, 3 and 5 are all sort of
04:02:00 7 minority effective.

04:02:01 8 Q. Have you reviewed briefs from
04:02:03 9 the Republican intervenors suggesting
04:02:05 10 that the math and science map is a
04:02:08 11 racial gerrymander?

04:02:11 12 A. Yes.

04:02:11 13 Q. And did you see any evidence of
04:02:13 14 racial gerrymandering in the data
04:02:16 15 that's reflected in the math and
04:02:17 16 science map?

04:02:19 17 A. No, I did not.

04:02:20 18 Q. What would you expect to see in
04:02:22 19 a racial gerrymandering situation?

04:02:26 20 A. So you might expect to see
04:02:28 21 things like failures of compactness or
04:02:28 22 if the tentacles and claws reaching
04:02:33 23 out to grab, you know, particularly in
04:02:36 24 densely populated regions of minority
04:02:39 25 voters. You might also expect to see,

04:02:39 1 you know, particular numerical targets
04:02:43 2 that are drawn, and I didn't observe
04:02:44 3 any of that in those three districts.

04:02:49 4 Q. Okay.

04:02:50 5 And based on your expertise and
04:02:53 6 your analyses of all of the different
04:02:55 7 maps, which map in your view best
04:02:58 8 complies with Pennsylvania's
04:03:00 9 constitutional and also the federal
04:03:02 10 criteria for redistricting?

04:03:05 11 A. The mathematician and science
04:03:11 12 map.

04:03:11 13 ATTORNEY RING-AMUNSON:

04:03:12 14 Thank you.

04:03:16 15 ATTORNEY SENOFF:

04:03:17 16 Your Honor, David
04:03:17 17 Senoff. I'd just object to the last
04:03:17 18 question and answer as being ---
04:03:18 19 calling for this witness to opine on
04:03:20 20 the law.

04:03:21 21 ATTORNEY RING-AMUNSON:

04:03:21 22 Your Honor, my response
04:03:22 23 is that I asked him in his expert
04:03:24 24 opinion. He's been offered and
04:03:29 25 stipulated as an expert in

04:03:31 1 redistricting.

04:03:31 2 ATTORNEY SENOFF:

04:03:31 3 But the question was
04:03:32 4 whether or not the constitutional
04:03:35 5 requirements as set forth in
04:03:40 6 particular Pennsylvania case law, not
04:03:42 7 whether it meets the standard in the
04:03:43 8 industry, for example, or standards by
04:03:46 9 which other redistricting plans are
04:03:54 10 judged. It specifically asks a
04:03:55 11 comparison to the Pennsylvania
04:03:57 12 Constitution and the Supreme Court's
04:03:58 13 decision of League of Women Voters.

04:04:00 14 JUDGE McCULLOUGH:

04:04:00 15 Counsel, either I need
04:04:02 16 to have the question read back or you
04:04:04 17 can restate the question.

04:04:05 18 ATTORNEY RING-AMUNSON:

04:04:05 19 I'm happy to restate the
04:04:07 20 question, Your Honor.

04:04:08 21 JUDGE McCULLOUGH:

04:04:08 22 Okay.

04:04:09 23 BY ATTORNEY RING-AMUNSON:

04:04:09 24 Q. With respect to your evaluation
04:04:10 25 of equal population, compactness,

04:04:13 1 contiguity, respecting political
04:04:17 2 subdivisions where unless absolutely
04:04:20 3 necessary, partisan fairness and
04:04:25 4 compliance with the Voting Rights Act,
04:04:27 5 which map performed the best in your
04:04:29 6 opinion as a redistricting expert?

04:04:30 7 A. The mathematician and scientist
04:04:32 8 map.

04:04:34 9 ATTORNEY RING-AMUNSON:

04:04:34 10 Thank you.

04:04:35 11 JUDGE McCULLOUGH:

04:04:35 12 Thank you. So we'll
04:04:36 13 proceed to Cross, and as we discussed
04:04:38 14 we're just going to keep going back up
04:04:40 15 to the top of the list. So Petitioner
04:05:16 16 Carter.

04:05:16 17 ATTORNEY GORDON:

04:05:16 18 Matthew Gordon for the
04:05:16 19 Carter Petitioners.

04:05:16 20 ---

04:05:16 21 CROSS EXAMINATION

04:05:18 22 ---

04:05:18 23 BY ATTORNEY GORDON:

04:05:18 24 Q. Good afternoon, Doctor DeFord.

04:05:18 25 A. Hi.

04:05:22 1 Q. Doctor DeFord, if I understand
04:05:23 2 you correctly, you did not perform an
04:05:25 3 evaluation of the core of retention
04:05:29 4 vis-a-vis the 2018 plan.

04:05:31 5 Is that correct?

04:05:31 6 A. That's correct.

04:05:32 7 Q. So you didn't do any analysis
04:05:34 8 of how much deviation the various
04:05:36 9 plans had from the 2018 plan?

04:05:39 10 A. That's correct.

04:05:40 11 Q. But you expressed some support
04:05:43 12 for the 2018 plan in your report
04:05:45 13 saying that it served as an effective
04:05:47 14 baseline for considering plans.

04:05:50 15 Correct?

04:05:51 16 A. That's correct. In particular
04:05:52 17 with respect to some of the decisions
04:05:54 18 that were made, you know,
04:05:58 19 prioritizing, say, borough splits over
04:05:58 20 county lines and things like that as
04:06:01 21 well.

04:06:01 22 Q. And you also opined in your
04:06:05 23 report, or you noted in your report
04:06:07 24 that the 2018 map was extensively
04:06:07 25 vetted and analyzed according to legal

04:06:12 1 and traditional redistricting
04:06:12 2 criteria.

04:06:12 3 Correct?

04:06:13 4 A. That's correct.

04:06:14 5 Q. And you said, and thus its
04:06:16 6 performance on metrics evaluating this
04:06:18 7 criteria can serve as a starting point
04:06:20 8 or baseline for identifying
04:06:22 9 potentially reasonable values for
04:06:24 10 plans created now.

04:06:25 11 Correct?

04:06:25 12 A. Yes, that's correct.

04:06:29 13 Q. I want to ask you a couple of
04:06:31 14 questions about subdivision splits.
04:06:33 15 If I understand correctly, you did not
04:06:35 16 evaluate precinct splits or VTD
04:06:40 17 splits.

04:06:40 18 Is that correct?

04:06:41 19 A. Yes, that's correct.

04:06:41 20 Q. You did evaluate the number of
04:06:48 21 borough splits.

04:06:49 22 Correct?

04:06:49 23 A. Yes.

04:06:50 24 Q. And I believe --- I want to
04:06:52 25 draw your attention to page 14 of your

04:06:54 1 initial report where you discussed the
04:06:56 2 borough splits. And at paragraph 42
04:06:56 3 here you first note that there are 955
04:06:56 4 boroughs in the state.

04:07:09 5 Correct?

04:07:09 6 A. Yes.

04:07:09 7 Q. And the GSM plan splits three
04:07:09 8 boroughs.

04:07:09 9 Correct?

04:07:11 10 A. Yes.

04:07:11 11 Q. And then you go on later in the
04:07:13 12 report on the next page, page 15,
04:07:15 13 paragraph 45, you say that the GSM map
04:07:21 14 split those three boroughs because it
04:07:23 15 was necessary to do so to preserve
04:07:26 16 county boundaries.

04:07:27 17 Do I have that right?

04:07:28 18 A. Yes, the borough boundary there
04:07:30 19 crosses the county boundary, and so if
04:07:33 20 those two counties are assigned in
04:07:35 21 different plans you have to make
04:07:36 22 decision to either split the borough
04:07:39 23 or split the county.

04:07:40 24 Q. And the GSM map made the
04:07:42 25 decision to split the borough instead

04:07:45 1 of the county?

04:07:46 2 A. That's correct. Following the
04:07:46 3 choice made in the 2018 plan, which
04:07:48 4 splits six boroughs but all for the
04:07:51 5 same reason.

04:07:51 6 Q. I'm sorry, I didn't hear
04:07:51 7 the ---.

04:07:52 8 A. I'm sorry all along --- all for
04:07:55 9 the same reason. They all sort of
04:07:57 10 cross the county line.

04:07:57 11 Q. And you said that you decided
04:08:00 12 in your analysis to not count these
04:08:05 13 three borough splits against the GSM
04:08:05 14 plan because they occurred along
04:08:05 15 county lines.

04:08:09 16 Correct?

04:08:09 17 A. That's correct.

04:08:10 18 Q. And you also noted that
04:08:11 19 counties are considered to be a more
04:08:13 20 fundamental political unit than
04:08:15 21 boroughs.

04:08:15 22 Correct?

04:08:16 23 A. That's correct.

04:08:16 24 Q. In other words, in your view
04:08:18 25 it's more important to avoid a county

04:08:22 1 split than a borough split.

04:08:22 2 Correct?

04:08:24 3 A. That's correct.

04:08:24 4 Q. I want to ask you a couple of
04:08:26 5 questions about your compactness
04:08:28 6 analysis.

04:08:28 7 A. Okay.

04:08:28 8 Q. I think you said in both your
04:08:30 9 report and on Direct Exam from Counsel
04:08:34 10 there are a number of different
04:08:36 11 compactness measures.

04:08:38 12 Right?

04:08:38 13 A. Yes.

04:08:38 14 Q. And each one accounts for a
04:08:40 15 slightly different piece of
04:08:42 16 information.

04:08:43 17 Correct?

04:08:43 18 A. That's correct.

04:08:43 19 Q. And I think you said in your
04:08:45 20 report that --- or maybe you didn't,
04:08:46 21 but do you have an opinion about
04:08:47 22 whether one of those compactness
04:08:48 23 measures is better than another?

04:08:52 24 A. I mean, I really do think that
04:08:53 25 they each capture something different

04:08:56 1 and so you certainly can construct
04:08:58 2 examples, where one of them would be
04:09:00 3 sort of appropriate for flagging the
04:09:03 4 failure of regularity of a boundary
04:09:03 5 but it would sort of pass a test based
04:09:09 6 on another metric.

04:09:09 7 Q. And in this particular case,
04:09:09 8 did you come to an opinion about which
04:09:11 9 of the compactness scores was more ---
04:09:13 10 was better to use in this particular
04:09:18 11 case for this map analysis than
04:09:20 12 others?

04:09:21 13 A. No, I didn't.

04:09:21 14 Q. And that's why you chose to
04:09:23 15 look at them all or four of them
04:09:26 16 together?

04:09:26 17 A. That's correct.

04:09:27 18 Q. And I think similarly ---
04:09:29 19 actually, I'll come back to that. I
04:09:31 20 wanted to ask you about your
04:09:32 21 discussion about the City of
04:09:33 22 Pittsburgh.

04:09:34 23 A. Yeah.

04:09:35 24 Q. And I think you mentioned that
04:09:38 25 you discussed the City of Pittsburgh,

04:09:41 1 if I understand correctly, to
04:09:43 2 illustrate that map makers had a
04:09:45 3 choice between keeping Pittsburgh
04:09:47 4 whole and by doing so, sacrificing
04:09:50 5 something on the Polsby-Popper
04:09:54 6 compactness score for splitting
04:09:55 7 Pittsburgh up and getting a better
04:10:01 8 Polsby-Popper Compactness score.

04:10:01 9 Is that accurate?

04:10:02 10 A. I'm not sure how to quite
04:10:05 11 process the question.

04:10:06 12 Q. Let me ask a different
04:10:08 13 question. I don't want to ask a
04:10:09 14 confusing question.

04:10:11 15 My understanding is that your
04:10:13 16 testimony indicated that if the map
04:10:15 17 kept Pittsburgh whole that would
04:10:17 18 necessarily result in a decrease of in
04:10:25 19 the Polsby-Popper compactness score.

04:10:26 20 Is that correct?

04:10:27 21 A. I think that it did in the
04:10:29 22 proposed plans at least.

04:10:29 23 Q. In the proposed plans that you
04:10:32 24 reviewed, keeping Pittsburgh whole was
04:10:32 25 a choice that resulted in a lower

04:10:37 1 Pol sby-Pop per compactness score?

04:10:40 2 A. Yes.

04:10:41 3 Q. And you would agree with me

04:10:44 4 that the Carter map kept the City of

04:10:45 5 Pittsburgh whole.

04:10:45 6 Correct?

04:10:46 7 A. Can I look at my report?

04:10:46 8 Sorry. I'm thinking about a lot of

04:10:47 9 maps here.

04:10:47 10 Q. Certainly. What page would you

04:10:49 11 like to look at?

04:10:50 12 A. There's a table on page seven

04:10:50 13 of the response report, Table 4. Yes.

04:11:06 14 Sorry, in answer to your question.

04:11:06 15 Q. Page seven of the response

04:11:08 16 report Table 4?

04:11:09 17 A. Yes, that's correct.

04:11:11 18 Q. Okay.

04:11:16 19 And does that confirm that the

04:11:20 20 Carter map kept Pittsburgh whole?

04:11:22 21 A. That's correct. Yeah.

04:11:22 22 Q. And so as a result of keeping

04:11:22 23 Pittsburgh Whole, the Carter map would

04:11:23 24 have necessarily scored lower on the

04:11:27 25 Pol sby-Pop per compactness score than

04:11:29 1 it otherwise would have had it chose
04:11:31 2 to split Pittsburgh?

04:11:31 3 A. I think that requires me to
04:11:34 4 draw conclusions of what would have
04:11:34 5 been done instead, but at least with
04:11:38 6 respect to the proposed maps that I
04:11:40 7 looked at, it was true that the ones
04:11:43 8 that split Pittsburgh had
04:11:47 9 Pilsby-Popper scores than the ones
04:11:47 10 that didn't.

04:11:47 11 Q. And I think you testified
04:11:48 12 earlier that if you included
04:11:50 13 Pittsburgh that would result in a ---
04:11:52 14 if Pittsburgh was a whole District
04:11:57 15 that would result in a lower
04:11:59 16 Pilsby-Popper score for these maps?

04:12:03 17 A. Right.

04:12:06 18 Q. Keeping on the rebuttal report,
04:12:09 19 Doctor DeFord, I'd like to turn to
04:12:12 20 page five, Table 2 of your rebuttal
04:12:14 21 report, please. If I understand
04:12:18 22 correctly, here you're looking at the
04:12:19 23 number of county splits.

04:12:21 24 Is that accurate?

04:12:22 25 A. Yes, in the top row.

04:12:23 1 Q. In the top row. And then you
04:12:26 2 also have number on non-intact
04:12:29 3 counties, number of pieces, correct.
04:12:30 4 And you would agree with me on this
04:12:33 5 metric the Carter map was slightly
04:12:36 6 better than the GMS map on county
04:12:38 7 splits?

04:12:38 8 A. That's correct.

04:12:38 9 Q. And in fact, it was one of the
04:12:40 10 --- it did better than most other maps
04:12:41 11 with respect to county splits, would
04:12:43 12 you agree with that?

04:12:44 13 A. That's correct.

04:12:44 14 Q. I want to ask you about
04:12:47 15 partisan fairness in your map --- I'm
04:12:51 16 sorry in your report. And you start
04:12:57 17 --- you start and you have some
04:13:00 18 metrics that you choose here to
04:13:01 19 evaluate partisan fairness. The first
04:13:03 20 one --- well, I'm sorry. Let me just
04:13:05 21 ask you a general question. Do you
04:13:07 22 recall generally how the Carter map
04:13:09 23 did on the partisan fairness criteria?

04:13:12 24 A. Can I look it up in the report.

04:13:13 25 Q. Well, let's go through --- I'll

04:13:15 1 ask you specific questions and then we
04:13:17 2 can circle back if you don't recall.
04:13:18 3 On page ten, paragraph 30, you're
04:13:24 4 discussing your metric that I believe
04:13:26 5 you called direct majority
04:13:29 6 responsiveness.

04:13:29 7 Do you recall that?

04:13:30 8 A. Yes.

04:13:30 9 Q. And in here you said that the
04:13:30 10 GSM tied for the fewest
04:13:30 11 anti-majoritarian outcomes, and you
04:13:30 12 identified three as reflected in the
04:13:30 13 Table 9 on the next page.

04:13:41 14 Correct?

04:13:42 15 A. Yes.

04:13:42 16 Q. And in fact, it tied with the
04:13:44 17 Carter map for the fewest
04:13:46 18 anti-majoritarian outcomes.

04:13:49 19 Correct?

04:13:50 20 A. Yes.

04:13:50 21 Q. And according to Table 9 here,
04:13:53 22 the Carter map had deviations, more
04:13:59 23 deviations that actually favored
04:14:02 24 Republicans than Democrats, two for
04:14:05 25 Republicans, one for Democrats.

04:14:06 1 Correct?

04:14:07 2 A. That's correct.

04:14:07 3 Q. And the fact that it had
04:14:08 4 deviations on both sides of the aisle
04:14:11 5 is a hallmark of --- or another
04:14:14 6 indicator of partisan fairness.

04:14:17 7 Correct?

04:14:17 8 A. Yes.

04:14:18 9 Q. I want to talk to you about
04:14:19 10 your mean median analysis that you
04:14:21 11 used to evaluate partisan symmetry.
04:14:26 12 If we could go to page 13, figure one.
04:14:32 13 Am I correct that the mean median
04:14:34 14 analysis was used to evaluate --- was
04:14:34 15 one of two measures to evaluate
04:14:40 16 partisan symmetry?

04:14:41 17 A. Yes.

04:14:41 18 Q. And I just wanted to ask you a
04:14:43 19 couple questions about the table or
04:14:45 20 the figure one here. Counsel asked
04:14:47 21 you about whether there were any plans
04:14:49 22 that did --- that faired poorly under
04:14:52 23 this, and I think you identified the
04:14:55 24 Republican Congressional Map 2 and 1
04:14:57 25 as performing particularly poorly

04:15:01 1 because all of the --- all of the
04:15:02 2 outcomes were on one side of the
04:15:03 3 aisle?
04:15:04 4 A. That's correct.
04:15:05 5 Q. And I want to draw your
04:15:05 6 attention to the House Republicans Map
04:15:11 7 showed a similar feature, all outcomes
04:15:11 8 favoring Republicans.
04:15:12 9 Correct?
04:15:13 10 A. That's also correct. Yes.
04:15:15 11 Q. So would you --- would you
04:15:15 12 agree with me that the House
04:15:17 13 Republicans map also fared
04:15:19 14 particularly poorly under this
04:15:21 15 analysis?
04:15:22 16 A. Yes, that's correct.
04:15:23 17 Q. Your efficiency gap analysis,
04:15:27 18 turning to the next page of your
04:15:29 19 report, Figure 2, you evaluate ---
04:15:31 20 this is another measure to evaluate
04:15:36 21 partisan symmetry.
04:15:37 22 Correct?
04:15:37 23 A. Yes.
04:15:38 24 Q. And you have, again, a similar
04:15:41 25 plot there. And then if we could go

04:15:43 1 to Table 13 on the next page you
04:15:45 2 calculate some mean scores for
04:15:46 3 efficiency gaps.
04:15:48 4 A. Yes.
04:15:49 5 Q. Do you see that?
04:15:50 6 A. Yes, that's correct.
04:15:54 7 Q. Now, if I understand correctly,
04:15:55 8 closest to zero here is an indication
04:15:55 9 of treating voters from each party
04:15:59 10 equally?
04:16:00 11 A. That's right.
04:16:00 12 Q. And farthest from zero is an
04:16:02 13 indication of less partisan symmetry,
04:16:07 14 i.e. favoring one party more than the
04:16:09 15 other.
04:16:09 16 Correct?
04:16:10 17 A. Yes.
04:16:10 18 Q. And the sign here negative
04:16:10 19 favors Republicans, positive favors
04:16:13 20 Democrats.
04:16:14 21 Correct?
04:16:14 22 A. That's correct.
04:16:15 23 Q. Under this metric, if we look
04:16:17 24 at the mean score, the Carter map had
04:16:19 25 the mean score closest to zero.

04:16:22 1 Correct?

04:16:22 2 A. That's correct.

04:16:23 3 Q. Indicating that under this
04:16:25 4 metric the Carter map performed best
04:16:27 5 in treating voters from each party
04:16:29 6 equally.

04:16:30 7 Correct?

04:16:31 8 A. With respect to the mean. It
04:16:32 9 has a slightly larger range of values
04:16:37 10 that are seen.

04:16:37 11 Q. Sure. And then with respect to
04:16:39 12 the mean also, the maps that do most
04:16:45 13 poorly under your analysis here are
04:16:47 14 the House Republicans map and the
04:16:49 15 Republican Congressional Maps 1 and 2.

04:16:55 16 Correct?

04:16:55 17 A. That's correct.

04:16:56 18 Q. And when you analyzed the
04:16:57 19 efficiency gap under more recent
04:17:00 20 elections, and I'd like to turn to
04:17:02 21 page 19 of your report, Figure 6, here
04:17:05 22 you calculate the average efficiency
04:17:08 23 gap from more recent elections, if I
04:17:10 24 understand that correctly, and here
04:17:11 25 again the Carter plan was closest to

04:17:13 1 zero on that one as well.

04:17:16 2 Is that correct? I'm sorry.

04:17:17 3 Did I pull --- I pulled up the wrong

04:17:19 4 one. Page 18, figure 4. My

04:17:22 5 apologies, Doctor.

04:17:23 6 A. But anyway, yes, that's

04:17:24 7 correct.

04:17:24 8 Q. Okay.

04:17:25 9 And you can see that reflected

04:17:26 10 in this correct figure now.

04:17:37 11 ATTORNEY GORDON:

04:17:37 12 No further questions.

04:17:38 13 Thank you for your time, Doctor

04:17:40 14 DeFord.

04:17:40 15 JUDGE McCULLOUGH:

04:17:40 16 Thank you, Counsel.

04:17:41 17 ATTORNEY GORDON:

04:17:41 18 Thank you, Your Honor.

04:17:42 19 JUDGE McCULLOUGH:

04:17:43 20 Counsel for Secretary

04:17:45 21 Chapman or Governor Wolf, whomever

04:17:51 22 you're coming up for.

04:17:51 23 ATTORNEY WIYGUL:

04:18:06 24 Thank you, Your Honor.

04:18:06 25 I'm appearing again in my role as

04:18:08 1 counsel for the Governor.

04:18:08 2 ---

04:18:08 3 CROSS EXAMINATION

04:18:08 4 ---

04:18:08 5 BY ATTORNEY WIYGUL:

04:18:12 6 Q. Good afternoon, Doctor DeFord.

04:18:13 7 A. Good afternoon.

04:18:14 8 Q. Could I start by also asking
04:18:14 9 you to review a portion of your
04:18:14 10 report.

04:18:14 11 ATTORNEY WIYGUL:

04:18:21 12 And if Ms. Frye would
04:18:21 13 please pull up Table 8 on page nine of
04:18:25 14 your rebuttal report.

04:18:25 15 BY ATTORNEY WIYGUL:

04:18:30 16 Q. These are the measures of
04:18:33 17 compactness that you've been talking
04:18:34 18 about.

04:18:34 19 Correct?

04:18:35 20 A. That's correct.

04:18:35 21 Q. And could you just tell us
04:18:36 22 which map under your calculation has
04:18:38 23 the best Polsby-Popper score?

04:18:42 24 A. That's the map proposed by the
04:18:44 25 Governor.

04:18:44 1 Q. And if we look at the mean
04:18:44 2 convex hull, which two maps there
04:18:50 3 score best?

04:18:50 4 A. The map proposed by the
04:18:53 5 Governor and the first Reschenthaler
04:18:54 6 map.

04:18:54 7 Q. And those two maps also score
04:18:56 8 the best under the cut edges metric.

04:18:59 9 Is that correct?

04:19:10 10 A. Yes, that's correct.

04:19:11 11 Q. And if we could go --- also a
04:19:11 12 table we've looked at already, but
04:19:13 13 Table 9 on page 11 of your --- of the
04:19:16 14 same report, please. And this is the
04:19:18 15 table that counsel's already discussed
04:19:20 16 shows deviations in each --- for each
04:19:22 17 plan under the various elections.

04:19:27 18 Correct?

04:19:27 19 A. Yes, that's correct.

04:19:27 20 Q. And is it true there's only one
04:19:30 21 plan listed here that has perfect
04:19:32 22 balance in the number of Democrat and
04:19:34 23 Republican favoring deviations?

04:19:34 24 A. Yes, although there are several
04:19:34 25 that are as good as possible given

04:19:43 1 they have an odd number of
04:19:44 2 anti-majoritarian results.
04:19:44 3 Q. Okay.
04:19:45 4 But you would agree with me the
04:19:46 5 Governor's map has an equal number of
04:19:49 6 Democrat versus Republican favoring
04:19:50 7 deviations?
04:19:51 8 A. Yes, that's correct.
04:19:52 9 Q. And could we look at Table 12
04:19:58 10 on page 15 of the same report, please?
04:20:01 11 This is the mean median scores table.
04:20:11 12 Correct?
04:20:12 13 A. Yes.
04:20:12 14 Q. And if we look at the mean
04:20:14 15 score row there, would you agree with
04:20:18 16 me that the Carter map and the
04:20:20 17 Governor's map score best under that
04:20:22 18 metric?
04:20:35 19 A. For the means score?
04:20:35 20 Q. For the mean score, yeah.
04:20:35 21 A. No.
04:20:40 22 Q. Am I wrong that you want to be
04:20:40 23 closer to zero?
04:20:41 24 A. That's correct.
04:20:42 25 Q. Okay.

04:20:42 1 So sorry. Maybe I'm misreading
04:20:44 2 it. Carter is .004.
04:20:47 3 Correct?
04:20:47 4 A. That's the maximum score.
04:20:50 5 Q. Are we looking at the wrong
04:20:51 6 table? I'm sorry my mistake.
04:20:54 7 Table 13.
04:20:59 8 A. So we're talking about the
04:21:00 9 efficiency gap now?
04:21:02 10 Q. Yes. I'm sorry. I was reading
04:21:04 11 the wrong label and the wrong table.
04:21:04 12 A. No worries.
04:21:06 13 Q. Okay.
04:21:07 14 Efficiency gap, now we can see
04:21:09 15 what I'm referring to. Would you
04:21:11 16 agree with me there that for mean
04:21:13 17 score the best performing maps by your
04:21:15 18 metric are the Governor's map and the
04:21:17 19 Carter map?
04:21:18 20 A. Yes, although again for the
04:21:26 21 mean score, not necessarily the range.
04:21:26 22 Q. Well, let's look at the range
04:21:28 23 as well. Would you agree with me that
04:21:29 24 the Governor's map scores well by that
04:21:32 25 metric?

04:21:34 1 A. Yes.

04:21:34 2 Q. When you were talking about
04:21:35 3 partisan fairness you mentioned using
04:21:38 4 Plan Score.

04:21:38 5 Do you recall that?

04:21:39 6 A. Yes.

04:21:39 7 Q. Okay.

04:21:40 8 And am I right that plan score
04:21:44 9 uses an election index that is blended
04:21:46 10 from a list of elections?

04:21:48 11 A. That's correct.

04:21:48 12 Q. Is this use of a blended
04:21:50 13 election index, in your professional
04:21:53 14 opinion, a superior approach to
04:21:55 15 looking at individual actual
04:21:56 16 elections?

04:21:57 17 A. No.

04:21:58 18 ATTORNEY WIYGUL:

04:21:58 19 Thank you. I have
04:21:59 20 nothing further.

04:22:05 21 JUDGE McCULLOUGH:

04:22:05 22 Thank you, Counsel. Now
04:22:07 23 Republican Intervenors, Senator
04:22:07 24 Cutler.

04:22:07 25 ---

04:22:07

1

CROSS EXAMINATION

04:22:11

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04:22:11

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BY ATTORNEY LEWIS:

04:22:43

4

Q. Doctor DeFord, good afternoon.

04:22:44

5

My name is Patrick Lewis. I represent

04:22:44

6

the Republican House Intervenor,

04:22:44

7

Brian Cutler and Kerry Benninghoff.

04:22:44

8

A. Good afternoon.

04:22:44

9

Q. Doctor DeFord, would you agree

04:22:54

10

that House Bill 2146 ---?

04:22:54

11

JUDGE McCULLOUGH:

04:22:54

12

Counsel, you can take

04:22:56

13

your mask off.

04:22:58

14

ATTORNEY LEWIS:

04:22:58

15

Sorry.

04:22:59

16

JUDGE McCULLOUGH:

04:22:59

17

That is fine.

04:23:00

18

BY ATTORNEY LEWIS:

04:23:01

19

Q. Would you agree, Doctor DeFord,

04:23:03

20

that House Bill 2146 broadly performs

04:23:07

21

in the same range as the other plans

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22

with respect to equal population,

04:23:13

23

contiguity, respect for keeping

04:23:16

24

political subdivisions whole and

04:23:18

25

compactness?

04:23:21 1 A. Broadly.

04:23:21 2 Q. Okay.

04:23:22 3 I'd like to turn to page eight
04:23:27 4 of your rebuttal report and
04:23:35 5 specifically Table 6. So you would
04:23:37 6 agree with me that --- would you agree
04:23:39 7 with me that House Bill 2146, which
04:23:42 8 you have as House Republicans on here,
04:23:45 9 splits the third least pieces of any
04:23:49 10 of the plans you studied?

04:23:52 11 A. Table 7?

04:23:56 12 Q. I apologize. You know what,
04:23:58 13 we'll go with Table 7 I'm fine with
04:24:01 14 that. Table 7

04:24:02 15 A. I'm sorry. Can you repeat the
04:24:03 16 question then?

04:24:04 17 Q. Yes, absolutely. So would you
04:24:06 18 agree with me that House Bill 2146
04:24:08 19 splits the third least pieces of any
04:24:11 20 of the plans you studied on Table 7?

04:24:13 21 A. That's correct.

04:24:14 22 Q. Okay.

04:24:15 23 Now, is there a reason that you
04:24:17 24 didn't provide a similar calculation
04:24:19 25 for precinct splits?

04:24:22 1 A. Precinct splits sort of weren't
04:24:25 2 listed in the six --- in the State
04:24:25 3 Constitution, and so I didn't consider
04:24:29 4 them here

04:24:29 5 Q. All right.

04:24:30 6 And would you agree, Doctor
04:24:32 7 DeFord, that it is not absolutely
04:24:34 8 necessary to split the City of
04:24:37 9 Pittsburgh in a plan?

04:24:42 10 A. Yes.

04:24:42 11 Q. Okay.

04:24:42 12 And Doctor DeFord, I'd like to
04:24:52 13 turn now to your analysis of --- you
04:24:52 14 have safe and responsive districts.
04:24:57 15 This was in page 32, Table 8, of your
04:24:58 16 opening report. All right. Let me
04:25:15 17 know when you're there?

04:25:16 18 A. Yes.

04:25:16 19 Q. Great. Now, here you show ---
04:25:17 20 I assume the house map, that's House
04:25:21 21 Bill 2146?

04:25:22 22 A. That's correct.

04:25:23 23 Q. Okay.

04:25:24 24 So here --- and my
04:25:25 25 understanding of your page 34, I've

04:25:27 1 got it up on the screen here, that you
04:25:28 2 would consider a district potentially
04:25:31 3 responsive if it elected at least, if
04:25:35 4 I understand this correctly, that the
04:25:38 5 district elects at least one R and one
04:25:40 6 D?

04:25:40 7 Is that right?

04:25:41 8 A. That's correct. This is a very
04:25:46 9 weak measure of responsiveness.

04:25:46 10 Q. Okay.

04:25:46 11 And on this measure the House
04:25:49 12 plan has the most responsive districts
04:25:53 13 of the three that you studied.

04:25:57 14 Right?

04:25:57 15 A. That's correct.

04:26:03 16 Q. Would you agree with me as well
04:26:04 17 that Governor Wolf's plan has the most
04:26:11 18 number of safe Democratic districts of
04:26:13 19 the three that you looked at?

04:26:14 20 A. That's correct.

04:26:14 21 Q. I'm going to turn to page 11 of
04:26:23 22 your report. We've all looked at this
04:26:27 23 table already. This is Table 9, your
04:26:29 24 majority responsiveness metric. I
04:26:33 25 just have a few questions for you on

04:26:34 1 that. Now, here you criticize House
04:26:37 2 Bill 2146 for having, page 11, I
04:26:39 3 believe you were describing as
04:26:43 4 anti-majoritarian outcomes. And those
04:26:43 5 are the shaded boxes on the chart.

04:26:46 6 Correct?

04:26:46 7 A. Yes.

04:26:46 8 Q. Now, it's fairly obvious here
04:26:48 9 that, you know, we have what, five you
04:26:54 10 believe are anti-majoritarian here?

04:26:59 11 A. Yes. That's right.

04:26:59 12 Q. But at least two of them,
04:27:03 13 auditor of 2012, auditor of 2016,
04:27:03 14 virtually every plan produces an
04:27:03 15 anti-majoritarian outcome.

04:27:11 16 Right?

04:27:12 17 A. That's true.

04:27:12 18 Q. So is it fair to say what we're
04:27:12 19 really focused on then would be the
04:27:15 20 other three races, Treasurer 12;
04:27:18 21 Governor, 12; and President, 20.

04:27:20 22 Right?

04:27:21 23 A. I think it's Treasurer, 12;
04:27:22 24 Attorney General, 16; and President,
04:27:26 25 20.

04:27:26 1 Q. I apologize. I had read the
04:27:27 2 wrong column.

04:27:30 3 Okay.

04:27:30 4 But as an example, in the 2012
04:27:35 5 elections, you have the same voters
04:27:42 6 voted in the 2012 general election for
04:27:45 7 all five races.

04:27:50 8 Right?

04:27:50 9 A. The same --- yes, that's
04:27:51 10 correct.

04:27:51 11 Q. Okay.

04:27:52 12 And so, in the same voters,
04:27:53 13 same elections, you've got - for the
04:27:57 14 House Republican plan you've got three
04:28:00 15 that are producing majoritarian
04:28:03 16 outcomes and two that are producing
04:28:04 17 anti-majoritarian outcomes.

04:28:06 18 Is that right?

04:28:07 19 A. That's correct.

04:28:08 20 Q. Actually, it's six. I
04:28:10 21 overlooked Attorney General.

04:28:10 22 Right?

04:28:11 23 Okay.

04:28:11 24 So we're doing --- we've got
04:28:12 25 four out of six. Aren't those

04:28:15 1 differences telling us that electoral
04:28:19 2 outcomes are being driven by voter
04:28:23 3 preferences and not the map itself?
04:28:23 4 A. Well it's a combination, right.
04:28:24 5 The position of the voters in sort of
04:28:24 6 they're, you know, voting in different
04:28:24 7 quantities and different regions
04:28:24 8 intersections with the map, because
04:28:24 9 the map sort of splits up those voters
04:28:39 10 based on their positions.
04:28:40 11 Q. It splits them up in the same
04:28:42 12 way for all six elections that you
04:28:42 13 studied that year.
04:28:42 14 Right?
04:28:43 15 A. It does, but there's --- you
04:28:44 16 know, the voters themselves could have
04:28:46 17 voted differently on those between
04:28:48 18 those candidates.
04:28:51 19 Q. I see. Now, I believe you
04:28:54 20 testified on Direct Examination that
04:28:57 21 you did not believe that an ensemble
04:29:05 22 analysis would have been informative
04:29:05 23 for your work in this case.
04:29:07 24 Is that right?
04:29:08 25 A. I believe I said it wasn't

04:29:10 1 necessary.

04:29:11 2 Q. We'll go with aren't necessary.

04:29:11 3 That's fair. And if I use the term

04:29:16 4 simulations, would you understand that

04:29:16 5 is being similar to ensemble?

04:29:22 6 A. Yes.

04:29:22 7 Q. Okay. All right.

04:29:22 8 Now, you were --- you did some

04:29:23 9 work for the Colorado Independent

04:29:29 10 Redistricting Commission this ---

04:29:29 11 2021, did you not?

04:29:30 12 A. Yes.

04:29:30 13 Q. And in fact, you used an

04:29:37 14 ensemble analysis in that case to

04:29:37 15 analyze multiple different proposals

04:29:40 16 for congressional districts in that

04:29:41 17 state, did you not?

04:29:42 18 A. That's correct.

04:29:43 19 Q. You did? Okay.

04:29:45 20 And you could have performed a

04:29:46 21 very similar analysis in this case,

04:29:49 22 couldn't you have?

04:29:51 23 A. The Carter analysis was really

04:29:55 24 tuned to something different that I

04:29:55 25 think is a meaningful distinction with

04:29:57 1 this case. So there our comparison
04:30:01 2 was to try to understand sort of what
04:30:01 3 was possible in terms of a collection
04:30:07 4 of metrics based on decisions that the
04:30:07 5 Commission was making in terms of
04:30:10 6 communities of interest it wanted to
04:30:11 7 preserve and sort of other aspects of
04:30:14 8 its deliberative process.

04:30:17 9 And so there the question was
04:30:19 10 sort of what is possible. And you
04:30:23 11 know, the Commission then wanted to
04:30:23 12 use that to help evaluate some of its
04:30:28 13 decision making. Here we have plenty
04:30:32 14 of examples of plans that are proposed
04:30:32 15 that perform really well under the
04:30:36 16 partisan fairness measures.

04:30:36 17 Q. Now, I believe you testified
04:30:46 18 that you were not sure of the --- let
04:30:49 19 me just ask it this way. You
04:30:53 20 understand that the GMS plan was
04:30:58 21 prepared using a computer algorithmic
04:30:58 22 technique.

04:31:07 23 Right?

04:31:08 24 A. Yes, they were used to assist
04:31:10 25 in that metric is my understanding.

04:31:11 1 Q. But you don't know exactly what
04:31:13 2 technique was used.

04:31:15 3 Right?

04:31:15 4 A. I do not.

04:31:16 5 Q. But did you understand that
04:31:17 6 that algorithm was looking to optimize
04:31:22 7 on partisan fairness and Voting Rights
04:31:25 8 Act compliance as well as traditional
04:31:27 9 districting principles?

04:31:28 10 A. I do not.

04:31:29 11 Q. Would it surprise you to learn
04:31:30 12 that that's how it's described on
04:31:32 13 page 14 of the Gressman Petitioner's
04:31:37 14 opening brief in this case?

04:31:40 15 A. Can you show me the page?

04:31:43 16 Q. Absolutely. So you see where
04:32:04 17 it says at the bottom of page 14 the
04:32:06 18 GMS plan remedies the malapportionment
04:32:10 19 now present in the 2018 plan while
04:32:14 20 also optimizing compliance with all
04:32:15 21 state and federal legal requirements.
04:32:15 22 Those legal requirements and those
04:32:18 23 metrics are set forth below.

04:32:19 24 Do you see that?

04:32:23 25 A. I do.

04:32:23 1 Q. So you see first we have equal
04:32:26 2 population. Right. I'm on page 15.
04:32:26 3 A. So sorry. Can I ask a question
04:32:29 4 about your question?
04:32:30 5 Q. Sure.
04:32:35 6 A. Can you go back up to the
04:32:37 7 previous quote?
04:32:38 8 Q. Absolutely.
04:32:39 9 A. So this is talking about the
04:32:41 10 plan itself, right, not the
04:32:43 11 methodology?
04:32:44 12 Q. That's correct.
04:32:47 13 A. Okay. Sorry. I can't draw any
04:32:49 14 conclusions from this about what
04:32:51 15 computational techniques were used.
04:32:52 16 Q. But it's possible that this
04:32:55 17 algorithm could have been attempting
04:32:57 18 to optimize for partisan fairness, you
04:32:58 19 know, using whatever metrics you
04:33:04 20 choose.
04:33:04 21 Right?
04:33:04 22 A. I don't have any knowledge of
04:33:05 23 that.
04:33:06 24 Q. Now, if a plan were being drawn
04:33:08 25 to, for example, try to find the

04:33:10 1 fairest plan using, for example,
04:33:14 2 mean-median, it would do so by drawing
04:33:16 3 districts that place voters into
04:33:19 4 districts in order to generate that
04:33:23 5 outcome.

04:33:26 6 Right?

04:33:27 7 A. If you're asking me to
04:33:29 8 speculate about an algorithm that I'm
04:33:35 9 not sure about.

04:33:35 10 Q. But the way you would draw ---
04:33:38 11 the point is that a map drawn to have
04:33:41 12 a zero mean-median gap, right, is
04:33:43 13 going --- by necessity, it's going to
04:33:45 14 be --- you're going to have to place
04:33:45 15 voters in the districts on the basis
04:33:47 16 of their partisanship.

04:33:50 17 Right?

04:33:53 18 A. I'm sorry. Again, I'm
04:33:55 19 struggling to figure out how I can
04:33:58 20 answer your question helpfully. So
04:34:04 21 are you asking across like any
04:34:06 22 possible algorithm for generating a
04:34:09 23 map? Is this ---?

04:34:09 24 Q. I'm just asking for any drawing
04:34:09 25 of a map at all. Sit down and draw a

04:34:09 1 map, I want a zero mean-median gap. I
04:34:09 2 have to --- if I'm going to achieve
04:34:17 3 that, don't I have to draw it and
04:34:19 4 place voters in basis on their
04:34:24 5 partisanship?

04:34:24 6 A. Well, not necessarily, right.
04:34:24 7 You could sort of generate a whole
04:34:26 8 bunch of maps just according to the
04:34:26 9 criteria and then look for those that
04:34:26 10 had that property, even if it didn't
04:34:26 11 have sort of partisan data available
04:34:40 12 to the algorithm.

04:34:41 13 Q. All right.

04:34:41 14 I would like to turn briefly to
04:34:43 15 your discussion then, Doctor DeFord,
04:34:45 16 of race, on the use of race in the
04:34:51 17 generation of --- your evaluation of
04:34:53 18 race in this particular plan. Did I
04:34:55 19 hear you correctly on Direct
04:34:57 20 Examination that you believed that if
04:34:59 21 the minority voting age population in
04:35:06 22 the Commonwealth of Pennsylvania is
04:35:07 23 about 20 percent, you'd expect there
04:35:08 24 to be about 20-percent
04:35:11 25 majority/minority districts?

04:35:12 1 A. Minority effective districts.

04:35:12 2 Q. And in this particular case,
04:35:14 3 the districts that you characterized
04:35:16 4 in your plan as minority effective
04:35:19 5 were all majority/minority.

04:35:21 6 Is that correct?

04:35:21 7 A. That's correct.

04:35:22 8 Q. Okay.

04:35:23 9 A. But they don't have to be to
04:35:25 10 satisfy that criteria.

04:35:26 11 Q. And in fact, would you agree
04:35:27 12 with me that in House Bill 2146 that
04:35:30 13 you studied, that District 5 was a
04:35:34 14 majority performing --- or a minority
04:35:37 15 performing --- excuse me, a minority
04:35:37 16 effective district?

04:35:39 17 A. Yes, that's correct.

04:35:39 18 Q. Okay.

04:35:42 19 And District 5 in the House
04:35:43 20 Bill plan had less than 50 percent
04:35:46 21 minority voting age population.

04:35:52 22 Isn't that right?

04:35:53 23 A. Can I look at the table or the
04:35:54 24 report? I'm sorry.

04:35:54 25 Q. Absolutely. We'll go there

04:35:58 1 together. What page?

04:35:59 2 A. Let me find it for you. We're

04:35:59 3 talking about District 5.

04:36:01 4 Is that correct?

04:36:03 5 Q. Yes. That's right. I had you

04:36:12 6 at page 50 --- around 51 of your

04:36:12 7 rebuttal report --- initial report.

04:36:12 8 Excuse me.

04:36:48 9 A. So I may not have reported that

04:36:50 10 number in my report.

04:36:51 11 Q. All right.

04:36:52 12 But you would agree with me

04:36:54 13 that House Bill 2146 drew only two

04:36:58 14 majority/minority districts in the

04:36:59 15 greater Philadelphia area, not three.

04:37:00 16 Right?

04:37:00 17 A. That's correct.

04:37:01 18 Q. Okay.

04:37:05 19 And we could use any statistics

04:37:07 20 we want to calculate the percentage of

04:37:10 21 minority voting population in District

04:37:10 22 5 in the House Bill plan.

04:37:14 23 Right?

04:37:14 24 A. In terms of like being

04:37:15 25 effective, is that ---?

04:37:15 1 Q. In terms of the ---.

04:37:17 2 A. Yes.

04:37:18 3 Q. Okay.

04:37:19 4 Percentage, perfect. Okay.

04:37:21 5 So now you're not giving an

04:37:22 6 opinion in this case as to whether

04:37:25 7 there's legally significant racially

04:37:25 8 polarized voting in Pennsylvania, are

04:37:35 9 you?

04:37:35 10 A. That's correct, in

04:37:36 11 Philadelphia, yeah.

04:37:36 12 Q. All right.

04:37:36 13 And in fact, your win rates

04:37:36 14 being over 50 percent means it can't

04:37:36 15 be said that minority-preferred

04:37:39 16 candidates of choice are usually being

04:37:41 17 defeated at polls by white block

04:37:51 18 voting.

04:37:52 19 Right?

04:37:52 20 A. Yes.

04:37:57 21 ATTORNEY LEWIS:

04:37:57 22 Nothing further, Your

04:37:58 23 Honor

04:37:58 24 JUDGE McCULLOUGH:

04:37:58 25 Okay.

04:37:58

1 Thank you. You beat the
2 clock by six seconds. The next party.
3 Congressional Intervenors, Congressman
4 Reschenthaler.

04:37:59

5 ATTORNEY VANCE:

6 Thank you, Your Honor.
7 Shohin Vance on behalf of the
8 Congressional Intervenors.

9

10

CROSS EXAMINATION

11

12

BY ATTORNEY VANCE:

13

Q. Good afternoon, Doctor DeFord.

04:38:26

14

A. Good afternoon.

04:38:26

15

Q. I'll start by asking you the

04:38:28

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same question my colleague did. Which

04:38:28

17

one's the best map?

04:38:29

18

A. The mathematicians and

04:38:35

19

scientists map.

04:38:36

20

Q. Okay.

04:38:36

21

Let's go through some of the

04:38:39

22

basic criteria first. Based on your

04:38:41

23

assessment, you would agree with me

04:38:42

24

that all of the submissions with the

04:38:44

25

exception of the House Democratic

04:38:47 1 Caucus's submission meets the zero
04:38:49 2 balance requirement?
04:38:49 3 A. The Carter map also has a
04:38:55 4 two-person deviation.
04:38:55 5 Q. Okay.
04:38:55 6 So all the other ones meet your
04:38:58 7 zero balance test?
04:39:01 8 A. Yes, that's correct.
04:39:02 9 Q. And with regard to contiguity,
04:39:05 10 you would agree with me that they're
04:39:07 11 all contiguous?
04:39:09 12 A. Yes.
04:39:09 13 Q. And on compactness I believe
04:39:11 14 the Reschenthaler 1 and 2, which I
04:39:15 15 believe in your table is Republican
04:39:17 16 Congressman 1 and 2, they have either
04:39:22 17 better or equal compactness scores on
04:39:28 18 every measure as compared to the GMS
04:39:33 19 map.
04:39:33 20 Is that correct?
04:39:34 21 A. That's correct, yeah, better or
04:39:36 22 equal.
04:39:36 23 Q. And then with regard to
04:39:40 24 splitting counties, you would agree
04:39:41 25 with me that the Reschenthaler 1 and 2

04:39:44 1 maps split less counties than the GMS
04:39:49 2 map?

04:39:49 3 A. Yes, that's correct.

04:39:50 4 Q. Okay.

04:39:50 5 And same is true with regard to
04:39:56 6 the number of segments or pieces as
04:39:59 7 you put it?

04:40:00 8 A. Yes.

04:40:00 9 Q. And same --- and as it pertains
04:40:04 10 to the number of municipal splits,
04:40:07 11 excluding counties, it's the same
04:40:10 12 between GMS and the Reschenthaler map.

04:40:13 13 Correct?

04:40:15 14 A. Ones here account for borough
04:40:17 15 splits along county lines and the
04:40:20 16 population of Pittsburgh. So there
04:40:21 17 are --- there's one more split
04:40:22 18 municipality in the Reschenthaler
04:40:22 19 maps, once you account for this. So
04:40:22 20 if you look at the number of split
04:40:22 21 municipalities not adjusted for those
04:40:22 22 things, then I believe there's one
04:40:42 23 more split for the Reschenthaler maps.

04:40:42 24 Q. And for all of those municipal
04:40:45 25 splits, county and non-county

04:40:48 1 municipal, again, with your reasonable
04:40:52 2 criteria, which I understand that you
04:40:53 3 exclude those that are along county
04:40:56 4 boundaries, the Reschenthaler maps
04:40:59 5 perform the best with regard to that
04:40:59 6 metric.

04:41:01 7 Right?

04:41:01 8 A. Tied with the mathematicians
04:41:04 9 and scientists map, yeah.

04:41:04 10 Q. Okay.

04:41:08 11 So you would agree then that it
04:41:09 12 is possible to produce a map and it is
04:41:13 13 not absolutely necessary to produce a
04:41:17 14 congressional districting map that
04:41:19 15 satisfies all of the basic criteria
04:41:22 16 that has less county splits than the
04:41:25 17 GSM map?

04:41:27 18 A. Oh, I see. Yes, as long as
04:41:33 19 I've got the right number of negatives
04:41:35 20 in that sentence, I think.

04:41:35 21 Q. I apologize. I want to ask you
04:41:37 22 about something you said about the
04:41:40 23 racial gerrymandering question. So is
04:41:46 24 it your testimony that, in your
04:41:48 25 professional view, based on your

04:41:51 1 experience in this field, the GMS map
04:41:55 2 was not drawn with racial
04:41:58 3 considerations in mind?

04:42:07 4 A. Well, I can't comment on what
04:42:08 5 sort of considerations were in mind
04:42:10 6 for the line drawers.

04:42:10 7 Q. But does it --- is it your view
04:42:11 8 --- again, I mean this is --- you're
04:42:12 9 --- you're the professional. So based
04:42:13 10 on your view and having reviewed the
04:42:15 11 map, you're testifying that you do not
04:42:19 12 believe that it was drawn to achieve
04:42:23 13 any type of minority composition and a
04:42:30 14 certain percentage of votes --- excuse
04:42:35 15 me, population?

04:42:35 16 A. And so I don't think --- I
04:42:38 17 concluded that it was not a racial
04:42:40 18 gerrymander.

04:42:45 19 Q. Okay.

04:42:46 20 So --- all right We'll move
04:42:46 21 on.

04:42:48 22 With regard to your fairness
04:42:51 23 metrics, let me start with the
04:43:03 24 majority responsiveness. Now, you ---
04:43:11 25 in analyzing majority responsiveness

04:43:15 1 the basic sort of principle, right, is
04:43:19 2 that people vote the same way based on
04:43:21 3 party. If one party wins statewide,
04:43:27 4 then more likely than not that is who
04:43:29 5 the person would vote for for
04:43:33 6 Congress?

04:43:36 7 A. Or at least an approximation of
04:43:38 8 that, yes.

04:43:39 9 Q. Okay.

04:43:39 10 And so based on that, you
04:43:41 11 calculated the majority
04:43:45 12 responsiveness. And that calculation
04:43:47 13 doesn't take into account fundraising,
04:43:51 14 incumbency, any of those other
04:43:53 15 considerations?

04:43:54 16 A. It does not.

04:43:56 17 Q. Okay.

04:43:56 18 Does it account for candidate
04:44:00 19 preference?

04:44:05 20 A. No, it does not, except to the
04:44:05 21 extent that that's sort of expressed
04:44:05 22 in the elections that are there
04:44:08 23 already.

04:44:08 24 Q. And does it account for
04:44:13 25 split-ticket voting?

04:44:18 1 A. Well ---.

04:44:18 2 Q. If you would like, I can
04:44:20 3 explain. People who vote for a
04:44:23 4 candidate of one party for one office
04:44:25 5 and a candidate of another party for
04:44:28 6 another office.

04:44:29 7 A. Well, sir, looking at the ---
8 you know, different elections on the
9 same ballot captured some of that. We
10 have --- we just talked about the
11 example in 2012 where you had very
12 similar overall statewide percentages
13 that --- different performance on some
14 of the maps because ---.

04:44:43 15 Q. But they're all statewide?

04:44:47 16 A. That's correct.

04:44:48 17 Q. So it doesn't measure, for
04:44:49 18 example, whether people prefer ---
04:44:51 19 whether people, for example, vote at
04:44:54 20 higher rates for different parties on
04:44:57 21 a local level?

04:45:00 22 A. That's correct I think.

04:45:01 23 Q. And so having analyzed the 2016
04:45:04 24 election for purposes of this measure,
04:45:10 25 would it surprise you to learn that of

04:45:13 1 the 18 congressional districts that
04:45:21 2 voted for the opposite party for
04:45:23 3 President than they did for Congress?

04:45:25 4 A. I don't have that in front of
04:45:27 5 me.

04:45:27 6 Q. Okay.

04:45:31 7 Also you --- in paragraph 104
04:45:38 8 you discuss the political geography of
04:45:42 9 the Commonwealth and there --- I
04:45:51 10 apologize

04:45:52 11 A. I'm sorry. Of the initial
04:45:52 12 report?

04:45:53 13 Q. Yes. You make the point that
04:45:55 14 there is a partisan --- and I'm
04:45:57 15 quoting, partisan advantage to
04:45:59 16 Republicans based on the political
04:46:02 17 geography of the state. So it is not
04:46:04 18 necessarily a surprise to see a slight
04:46:08 19 tilt favoring Republicans on these two
04:46:12 20 metrics, which were the metrics you
04:46:15 21 discussed.

04:46:17 22 Is that accurate?

04:46:18 23 A. Yes, that's correct.

04:46:18 24 Q. And in fact, you say --- I
04:46:29 25 apologize. In the Philadelphia ---

04:46:30 1 for example, there were over 1,000
04:46:30 2 voting districts that supported the
04:46:30 3 Democratic candidate in the 2020
04:46:34 4 Presidential Election by 90 percent or
04:46:36 5 more, mostly in the Philadelphia and
04:46:38 6 Pittsburgh areas. By contrast, there
04:46:40 7 were fewer than 50 voting districts in
04:46:40 8 the Commonwealth that had a similar
04:46:44 9 level of support for the Republican
04:46:47 10 candidate. Meaning that there is not
04:46:49 11 a part of the state where Republican
04:46:52 12 voters are as heavily concentrated as
04:46:56 13 Democratic voters are in the
04:46:58 14 Philadelphia and Pittsburgh areas.

04:46:59 15 Did I read that right?

04:47:00 16 A. Yes.

04:47:01 17 Q. Okay.

04:47:01 18 Now, also when you're doing the
04:47:03 19 --- I believe it was the mean-median
04:47:08 20 analysis, you make the point that more
04:47:12 21 recent elections are more --- and this
04:47:14 22 is paragraph 101, are more likely to
04:47:27 23 be reflective of the current political
04:47:28 24 geography.

04:47:28 25 Is that right?

04:47:29 1 A. Yes.

04:47:29 2 Q. Okay.

04:47:30 3 But --- and you --- and you

04:47:30 4 point out in your mean-median and

04:47:34 5 efficiency gap analysis the difference

04:47:34 6 based on year breakdown, but you don't

04:47:35 7 do that with the majority

04:47:38 8 responsiveness measurement, do you?

04:47:40 9 A. That's correct, although you

04:47:41 10 can read it off the table.

04:47:41 11 Q. So turning back to that, if we

04:47:43 12 look at the elections after 2016, so

04:47:45 13 2017 on down to 2020, the majority

04:47:50 14 responsiveness of the Reschenthaler

04:47:54 15 maps are the exact same as the GMS

04:47:59 16 ones, are they not?

04:48:01 17 A. Sorry. We're back to the other

04:48:03 18 report now.

04:48:03 19 Q. Sorry.

04:48:09 20 A. Let's see here. So you said

04:48:09 21 from 2016 forward?

04:48:12 22 Q. Correct. So Supreme Court

04:48:13 23 2017; United States Senate, 2018;

04:48:20 24 Governor, 2018 and then four different

04:48:23 25 elections in 2020?

04:48:24 1 A. And sorry, what was the
04:48:26 2 question about those elections?
04:48:26 3 Q. So the majority responsiveness
04:48:29 4 by your calculation would be the exact
04:48:33 5 same for the GSM map and the
04:48:35 6 Reschenthaler maps?
04:48:36 7 A. No, that's not correct.
04:48:38 8 Q. For those ---?
04:48:39 9 A. The President Election in 2020
04:48:41 10 I believe is anti-majoritarian for the
04:48:41 11 Reschenthaler maps.
04:48:42 12 Q. Oh, excuse me. It would be one
04:48:45 13 off.
04:48:46 14 Is that right?
04:48:47 15 A. Right. So across those
04:48:48 16 elections, the math and scientists map
04:48:54 17 has no anti-majoritarian results. The
04:48:54 18 Reschenthaler map has one.
04:48:54 19 Q. Has one?
04:48:54 20 A. That's correct.
04:48:55 21 Q. And that's based on this
04:48:59 22 measurement, which again you said
04:49:00 23 doesn't account for the other --- for
04:49:02 24 any factor than what you've stated?
04:49:05 25 A. That's correct.

04:49:05 1 Q. And are there other --- you
04:49:10 2 mentioned a winner's bonus, but
04:49:12 3 there's no further discussion of that,
04:49:13 4 nor is it --- I don't see it as being
04:49:15 5 part of the calculation.

04:49:18 6 A. Is there a question I can
04:49:20 7 answer?

04:49:21 8 Q. Yeah. Is there --- is there a
04:49:22 9 reason why you left that out?

04:49:24 10 A. So the winner's bonus is a
04:49:24 11 concept --- and I think Professor
04:49:24 12 Rodden mentioned this as well, that
04:49:32 13 for --- you know, the winning party
04:49:32 14 might expect to get some larger number
04:49:34 15 of seats than its vote percentage, you
04:49:37 16 know, in terms of its difference from
04:49:39 17 50 percent. But there isn't certain
04:49:42 18 broad agreement over what makes for a
04:49:44 19 good amount of winner's bonus.
04:49:48 20 There's just sort of an agreement
04:49:51 21 that tends to exist in these types of
04:49:51 22 elections. So in my initial report I
04:49:51 23 highlighted regions --- plan that
04:49:55 24 would have corresponded to points that
04:50:01 25 would have failed to have a winner's

04:50:02 1 bonus, but there were no ---.
04:50:03 2 Q. I'm sorry. I don't mean to
04:50:05 3 interrupt, and your counsel can
04:50:05 4 Redirect if necessary, but we're on a
04:50:08 5 clock, so ---.

04:50:08 6 ATTORNEY ATTISANO:
04:50:09 7 Objection, Your Honor.
04:50:09 8 I ask that the witness be allowed to
04:50:15 9 finish his answer.

04:50:15 10 ATTORNEY VANCE:
04:50:15 11 I got the answer as to
04:50:16 12 why he didn't include it in his report
04:50:18 13 so I appreciate that. I think if his
04:50:21 14 --- if they wish to further elaborate
04:50:23 15 on that on Redirect, I'm sure they
04:50:25 16 will do so.

04:50:27 17 ATTORNEY ATTISANO:
04:50:27 18 It's the witness's
04:50:28 19 answer, not the attorney's answer.

04:50:29 20 JUDGE McCULLOUGH:
04:50:30 21 Counsel, I think the
04:50:31 22 attorney said he got the answer. And
04:50:32 23 we are on a time limitation, so ---

04:50:34 24 ATTORNEY ATTISANO:
04:50:34 25 Yes, Your Honor.

04:50:35

1

JUDGE McCULLOUGH:

04:50:35

2

--- you can ask about it

04:50:36

3

if you would like.

04:50:43

4

BY ATTORNEY VANCE:

04:50:43

5

Q. And with regard to that, the

04:50:45

6

fact that there can be differences,

04:50:47

7

your table doesn't --- or your

04:50:48

8

measurement doesn't account for how

04:50:50

9

much of a, so to speak or to use your

04:50:54

10

phrase, majoritarian nonresponsiveness

04:51:00

11

or responsiveness in that path, right,

04:51:01

12

so it's essentially binary?

04:51:02

13

A. That's correct.

04:51:03

14

Q. Okay.

04:51:04

15

So as long as one map yields

04:51:11

16

the same --- or as long as the

04:51:14

17

majority of the seats under --- as

04:51:17

18

measured against one election go to

04:51:19

19

that party, that's it, there's no

04:51:22

20

other addition for whether the

04:51:26

21

difference, the gap is maybe 30

04:51:31

22

percent or 10 percent or whatever the

04:51:33

23

case may be?

04:51:33

24

A. Yes, that's correct.

04:51:34

25

Q. Okay.

04:51:41 1 Now, you started out by
04:51:50 2 describing --- by explaining that the
04:51:51 3 goal here is in measuring with some of
04:51:54 4 these measurements is fairness, but
04:52:00 5 --- and you use obviously the majority
04:52:05 6 responsiveness as a criterion. But
04:52:06 7 you don't quite explain and provide
04:52:09 8 any literature, and I think in
04:52:11 9 paragraph 73, on whether this has
04:52:15 10 actually been an accurate predictor?
04:52:19 11 A. So majoritarianism, this idea
04:52:19 12 that, you know, a majority of the
04:52:25 13 votes should translate to a majority
04:52:25 14 of the seats is usually sort of the
04:52:29 15 starting point for and just kind of
04:52:30 16 the baseline for the parties ---.
04:52:30 17 Q. So it's just part of the
04:52:32 18 analysis and it's s potentially
04:52:35 19 flawed?
04:52:36 20 A. It's useful certainly.
04:52:38 21 Q. Okay.
04:52:42 22 So --- and you also, I believe,
04:52:48 23 acknowledge that, given the multitude
04:52:51 24 of variables that must be balanced, it
04:52:56 25 is not easy to produce a map that is

04:52:59 1 perfectly compact and that has the
04:53:03 2 highest compactness score.

04:53:05 3 Right?

04:53:06 4 A. Yes, that's correct.

04:53:06 5 Q. So that, to your mind, is not
04:53:09 6 the most important measure?

04:53:10 7 A. That's correct.

04:53:11 8 Q. Okay.

04:53:13 9 And is it correct that, based
04:53:16 10 on the efficiency gap analysis,
04:53:23 11 Table 12 of your response brief ---

04:53:26 12 A. Table 13 maybe?

04:53:28 13 Q. --- correct --- the most --- I
04:53:37 14 apologize, Table 12. So I'm looking
04:53:43 15 at the mean-median. The most
04:53:45 16 politically gerrymandered map is the
04:53:50 17 Governor's with the biggest range
04:53:51 18 under Table 12?

04:53:53 19 A. Well, I don't think that I
04:53:56 20 would characterize that as proving
04:53:58 21 anything about gerrymandering.

04:53:58 22 Q. But it has the largest range?

04:54:00 23 A. That's correct.

04:54:01 24 Q. And so in that regard it is the
04:54:04 25 least responsive to the political

04:54:10 1 leanings of the state?

04:54:12 2 A. No. So the range here is

04:54:13 3 capturing the sort of distance between

04:54:14 4 the sort of most Republican favoring

04:54:14 5 value that was observed and the most

04:54:17 6 Democratic favoring value.

04:54:17 7 Q. So it's polarizing then?

04:54:23 8 A. It has the largest --- or the

04:54:23 9 largest gap between those two.

04:54:23 10 Q. The largest polarity?

04:54:27 11 A. Yes.

04:54:29 12 Q. Okay. Thank you.

04:54:29 13 ATTORNEY VANCE:

04:54:30 14 I have no further

04:54:30 15 questions.

04:54:31 16 JUDGE McCULLOUGH:

04:54:31 17 Thank you, Counsel.

04:54:38 18 Okay. Next is Representative

04:54:38 19 McClinton.

04:54:58 20 ATTORNEY SENOFF:

04:55:00 21 Your Honor, good

04:55:02 22 afternoon.

04:55:02 23 ---

04:55:02 24 CROSS EXAMINATION

04:55:02 25 ---

04:55:02 1 BY ATTORNEY SENOFF:

04:55:03 2 Q. Just because I brought my
04:55:05 3 computer and some more papers up, I
04:55:08 4 still only have a few questions for
04:55:09 5 you, Doctor, hopefully.
04:55:13 6 Doctor, you said in response to
04:55:16 7 somebody's --- one of the counsels'
04:55:18 8 questions that the GMS map performed
04:55:20 9 remarkably well for these metrics. Do
04:55:24 10 you remember that testimony?

04:55:25 11 A. Yes.

04:55:25 12 Q. Can you just remind me what
04:55:27 13 those metrics were?

04:55:29 14 A. Sure. So the majoritarian
04:55:33 15 responsiveness or the ability to
04:55:34 16 convert, you know, majorities into,
04:55:34 17 you know, votes into majorities of
04:55:34 18 seats as well as sort of the partisan
04:55:34 19 symmetry measures and everything
04:55:43 20 measured on plan score.

04:55:43 21 Q. Okay.

04:55:44 22 And those metrics, were you ---
04:55:47 23 did you independently arrive at them
04:55:50 24 to analyze or were they given to you?

04:55:52 25 A. So they were my decision. The

04:55:55 1 mean-median and efficiency gap were
04:55:55 2 sort of testified about heavily in
04:56:01 3 League of Women Voters by experts, so
04:56:01 4 that's why I picked those. And the
04:56:01 5 majority responsiveness, like I said
04:56:01 6 recently, really is a starting place
04:56:13 7 for thinking about partisan fairness.
04:56:13 8 Q. And the factors that you
04:56:14 9 testified are contained or, you know,
04:56:18 10 in your opinion are contained within
04:56:19 11 the Pennsylvania Constitution, how did
04:56:23 12 those factors factor into your general
04:56:31 13 metrics that you said the GMS map
04:56:33 14 performed remarkably well under?
04:56:35 15 A. So they are, you know, intended
04:56:35 16 to be sort of responsive to the free
04:56:38 17 and fair elections clause in terms of
04:56:39 18 treating voters from both parties
04:56:43 19 equally.
04:56:43 20 Q. And so were you aware of those
04:56:46 21 metrics in the Pennsylvania
04:56:48 22 Constitution before you were retained
04:56:51 23 for this case?
04:56:55 24 A. Well, so --- sorry. Let me ---
04:56:55 25 I don't think the metrics are in

04:56:55 1 the ---.

04:56:55 2 Q. I'm sorry. Not the metrics,
04:56:57 3 the factors. You selected the
04:57:01 4 metrics. I'm just talking about the
04:57:04 5 elements, let's call them, within the
04:57:07 6 constitutional structure in
04:57:08 7 Pennsylvania.

04:57:08 8 A. I mean, so I had read the
04:57:14 9 League of Women Voters ruling as it
04:57:14 10 came out.

04:57:14 11 Q. Now, turning more specifically
04:57:17 12 to the maps, would you agree with me
04:57:20 13 that within a certain relatively
04:57:21 14 narrow band all of the maps based on
04:57:25 15 these metrics are relatively close
04:57:29 16 together?

04:57:33 17 A. I'm not sure that's true for
04:57:34 18 all of the metrics. I think there's a
04:57:38 19 range of values, for example, on
04:57:41 20 splits.

04:57:41 21 Q. But in terms of the results,
04:57:43 22 there are certainly no map that you
04:57:46 23 reviewed for this case that would
04:57:49 24 produce a result like 15
04:57:52 25 Representatives for one party and

04:57:54 1 three Representatives for another in
04:57:56 2 an 18-Representative state?

04:58:04 3 A. Sorry. None of the maps had 18
04:58:07 4 districts. I'm not sure ---.

04:58:07 5 Q. Well, okay. But in terms of
04:58:08 6 being lopsided, right, I mean 15 to 3
04:58:13 7 out of 18, you know, there's no map
04:58:14 8 that you've reviewed for this case
04:58:16 9 that has that same kind of lopsided
04:58:19 10 result.

04:58:19 11 Right?

04:58:23 12 A. Not across the elections I
04:58:24 13 looked at, that's right.

04:58:24 14 Q. Now, there was a lot of
04:58:26 15 discussion about the 2016 election and
04:58:33 16 your rebuttal report, and I believe
04:58:35 17 it's Table 9 of that report. Do you
04:58:37 18 have that?

04:58:38 19 A. Yes.

04:58:38 20 Q. So --- actually, I'm glad
04:58:41 21 you're here because I've always wanted
04:58:43 22 to ask somebody about the results of
04:58:45 23 this election. So do you know what is
04:58:49 24 meant when people refer to as row
04:58:51 25 offices?

04:58:52 1 A. No, I don't.

04:58:53 2 Q. Okay.

04:58:55 3 So those are statewide. Just
04:58:56 4 so we're clear, I'm going to refer to
04:58:58 5 the row offices as the Auditor, the
04:59:03 6 Attorney General, and the Treasurer?

04:59:10 7 A. Okay.

04:59:10 8 Q. And in this case, in 2016, you
04:59:12 9 showed us that in comparison to the
04:59:16 10 Presidential Election, which was also
04:59:18 11 a statewide election, correct ---

04:59:20 12 A. Yes.

04:59:21 13 Q. --- that President Trump we
04:59:26 14 know defeated Secretary Clinton at
04:59:28 15 that time.

04:59:28 16 Right?

04:59:32 17 A. That's correct.

04:59:33 18 Q. And we know that the row
04:59:34 19 offices were Democrat --- resulted in
04:59:39 20 a Democratic sweep?

04:59:42 21 A. Yes.

04:59:42 22 Q. So given that, did you --- I
04:59:45 23 know you've showed us the percentages,
04:59:47 24 but did you consider the raw votes? I
04:59:50 25 mean, obviously, you had to calculate

04:59:52 1 the percentage, but did you consider
04:59:53 2 the raw votes in those elections?

04:59:56 3 A. I used them to compute the
04:59:58 4 percentages.

04:59:59 5 Q. So the Secretary's, the
05:00:03 6 Secretary of the Commonwealth's
05:00:05 7 website still has the raw votes up and
05:00:08 8 the raw votes show that President
05:00:11 9 Trump defeated Secretary Clinton by
05:00:13 10 approximately 14,292 votes. Does that
05:00:20 11 comport with your recollection?

05:00:22 12 A. It was certainly close, yeah.

05:00:22 13 Q. Okay.

05:00:23 14 And in the Attorney General's
05:00:25 15 race, which was a race where there was
05:00:30 16 no incumbent, the Republican candidate
05:00:30 17 was a State Senator, Senator Rafferty,
05:00:30 18 Democratic candidate is the current
05:00:38 19 Attorney General, Josh Shapiro, who
05:00:39 20 was a former State Representative,
05:00:41 21 Attorney General Shapiro garnered just
05:00:47 22 over 3 million votes and Senator
05:00:47 23 Rafferty garnered about 2. --- almost
05:00:55 24 2.9 million votes.

05:00:55 25 Now, Attorney General Shapiro

05:00:57 1 was the highest statewide vote getter
05:00:58 2 that year. Do you recall that when
05:00:59 3 you put this table together?

05:01:01 4 A. I'm not sure.

05:01:02 5 Q. And is there a reason why or do
05:01:10 6 you take into account in terms of
05:01:12 7 putting this chart together these
05:01:14 8 kinds of anomalous results where, for
05:01:18 9 example, both federal races that were
05:01:22 10 on the ballot that year were won by
05:01:25 11 Republicans, President Trump and
05:01:28 12 Senator Toomey, whereas the row
05:01:29 13 offices were won by Democrats. Do you
05:01:31 14 --- is there an explanation for that,
05:01:32 15 that's applicable to the districting
05:01:37 16 that we're talking about here?

05:01:38 17 A. Well, that's one of the reasons
05:01:40 18 to look at sort of a broad collection
05:01:42 19 of elections. Even on the same ballot
05:01:43 20 the distribution of voters can be
05:01:45 21 different as you're pointing out. And
05:01:47 22 it was also true in 2020 here in
05:01:49 23 Pennsylvania as well, you know, at the
05:01:51 24 statewide level. And that's why it's
05:01:52 25 sort of informative to look at those

05:01:55 1 separately and try to understand how
05:01:57 2 the distribution of voters in those
05:02:00 3 elections differed under the maps.

05:02:00 4 Q. So would you agree with me,
05:02:02 5 though, that the distribution of
05:02:03 6 voters across the State can vary like
05:02:06 7 we see in the 2016 and the 2020
05:02:09 8 results?

05:02:09 9 A. Yes.

05:02:10 10 Q. And similarly, they can vary at
05:02:12 11 the local level.

05:02:14 12 Correct?

05:02:15 13 A. Yes.

05:02:15 14 Q. And is there --- there's no
05:02:18 15 correlation from one election --- in
05:02:20 16 one election cycle to the distribution
05:02:23 17 of votes at, for example, the federal
05:02:26 18 level versus the state row office
05:02:31 19 level versus the district level.

05:02:32 20 Is that fair to say?

05:02:33 21 A. No, I wouldn't say there's no
05:02:34 22 correlation.

05:02:34 23 Q. But the correlation, you would
05:02:35 24 agree with me, certainly you couldn't
05:02:37 25 look at these four elections or five

05:02:40 1 elections in 2016 and look at a
05:02:43 2 specific congressional district and be
05:02:46 3 able to, you know, put a blindfold on
05:02:49 4 and figure out who won that
05:02:53 5 congressional District.

05:02:54 6 Right?

05:02:54 7 A. That's correct, although I
05:02:55 8 think you can make an informed
05:02:58 9 inference.

05:02:58 10 Q. Now, just talking briefly about
05:03:01 11 your role here today and what brought
05:03:04 12 you here, your role was not to offer
05:03:07 13 an opinion on the constitutionality
05:03:09 14 broadly of those maps, of any of these
05:03:12 15 maps.

05:03:13 16 Right?

05:03:13 17 A. That's right.

05:03:15 18 Q. And in creating your plan and
05:03:18 19 developing your metrics, did you
05:03:22 20 consider an overall statewide voter
05:03:26 21 registration as it relates to party
05:03:28 22 affiliation?

05:03:29 23 A. To be fair, I didn't create the
05:03:31 24 plan. I didn't have anything to do
05:03:33 25 with that process.

05:03:33 1 Q. I'm sorry. In your metrics,
05:03:35 2 when you tested the plan did you
05:03:37 3 consider that?
05:03:37 4 A. No, I did not.
05:03:38 5 Q. And in reaching your
05:03:40 6 conclusions that you have testified
05:03:44 7 about here today, and I won't go
05:03:47 8 through them all again with you, but
05:03:49 9 in reaching those conclusions, did you
05:03:52 10 consider a voter dilution or
05:04:01 11 disenfranchisement at all within your
05:04:07 12 --- the metrics you testified about
05:04:08 13 that you created?
05:04:10 14 A. Can you define what you mean by
05:04:11 15 those terms?
05:04:11 16 Q. Well, I mean, in --- you said
05:04:11 17 you read the League of Women Voters
05:04:15 18 case.
05:04:15 19 Correct?
05:04:16 20 A. Yes.
05:04:16 21 Q. Okay.
05:04:17 22 So in the League of Women
05:04:19 23 Voters case the Supreme Court said
05:04:21 24 that one of the overarching principles
05:04:24 25 of the Pennsylvania Constitution was

05:04:26 1 to prevent dilution of an individual's
05:04:29 2 vote. So with that in mind, can you
05:04:32 3 tell me, is there something in one of
05:04:34 4 your metrics that captures that?

05:04:36 5 A. Yes. So I think the measures
05:04:40 6 of partisan fairness that I evaluated
05:04:43 7 are relevant to that question.

05:04:43 8 Q. And is it fair to say that of
05:04:47 9 all the maps you reviewed, and I'm not
05:04:49 10 going to ask you which one was better,
05:04:51 11 but were there some maps that didn't
05:04:54 12 consider partisan fairness and some
05:04:56 13 maps that did?

05:04:59 14 A. I'm not sure what you mean by
05:05:00 15 consider?

05:05:01 16 Q. In other words, were there some
05:05:03 17 plans that considered what you just
05:05:05 18 referred to as partisan fairness as
05:05:07 19 opposed to other maps that did not
05:05:09 20 consider partisan fairness?

05:05:12 21 A. I'm sorry. Who's doing the
05:05:13 22 considering?

05:05:14 23 Q. You. In other words, in your
05:05:16 24 review --- in your review of the other
05:05:19 25 reports, did you find any other

05:05:21 1 reports, for example, that did not
05:05:23 2 consider partisan fairness?
05:05:29 3 A. I think at least one report was
05:05:33 4 filed that only reported on splits,
05:05:36 5 for example. I'd have to sort of look
05:05:42 6 back through them to recall the rest.
05:05:42 7 Q. And as you used the term
05:05:43 8 partisan fairness, what metric would
05:05:45 9 you expect that to be reflected in?
05:05:49 10 A. So a broad collection of
05:05:55 11 metrics, including the ones that I
05:05:57 12 analyzed in this report and the ones
05:05:57 13 reported on plan score and, you know,
05:06:00 14 other measures of majoritarianism.
05:06:02 15 Q. So does that include
05:06:06 16 compactness?
05:06:06 17 A. So --- sorry. Can you repeat
05:06:09 18 the question?
05:06:10 19 Q. Yeah. In other words, can you
05:06:12 20 establish partisan fairness by looking
05:06:13 21 at the compactness element?
05:06:20 22 A. I mean, the compactness doesn't
05:06:25 23 measure anything about partisanship
05:06:26 24 directly.
05:06:26 25 Q. Does contiguity measure

05:06:31 1 anything about partisan fairness

05:06:32 2 directly?

05:06:32 3 A. No.

05:06:33 4 Q. Is there one factor that you
05:06:34 5 can point to that specifically or in
05:06:36 6 part measures partisan fairness?

05:06:42 7 A. I mean, the partisan fairness
05:06:45 8 measures themselves.

05:06:45 9 Q. Right. And what --- what I'm
05:06:46 10 getting at ---

05:06:46 11 A. Sorry.

05:06:48 12 Q. --- and I'm not trying to be
05:06:50 13 difficult here, is just what --- you
05:06:50 14 know, in all these reports these
05:06:55 15 factors, metrics, are referred to by
05:06:56 16 different names, right, and so I'm
05:06:57 17 trying to find out if there's a common
05:06:59 18 word that's used across all of these,
05:07:02 19 for example --- all of these reports
05:07:02 20 that would reflect partisan fairness.

05:07:05 21 A. I mean I would use partisan
05:07:07 22 fairness.

05:07:08 23 Q. I understand.

05:07:09 24 A. I think it was sort of listed
05:07:11 25 in different subheadings in probably

05:07:13 1 each of the reports, partisan
05:07:13 2 performance or vote dilution and
05:07:22 3 things like that.
05:07:22 4 Q. But you would expect to see the
05:07:23 5 word partisan something in those
05:07:23 6 reports.
05:07:25 7 Is that right?
05:07:25 8 A. I see, yes.
05:07:28 9 ATTORNEY SENOFF:
05:07:28 10 Thank you. I don't have
05:07:29 11 any other questions.
05:07:30 12 JUDGE MCCULLOUGH:
05:07:30 13 Then the Counsel for
05:07:31 14 Senator Costa, is that Mr. Attisano.
05:07:57 15 ATTORNEY ATTISANO:
05:07:57 16 Thank you.
05:07:57 17 ---
05:07:57 18 CROSS EXAMINATION
05:08:05 19 ---
05:08:05 20 BY ATTORNEY ATTISANO:
05:08:06 21 Q. Doctor DeFord, did you take
05:08:07 22 into consideration any communities of
05:08:09 23 interest in your evaluation?
05:08:13 24 A. Just the --- the municipal
05:08:13 25 boundaries that are supposed to be

05:08:17 1 preserved.

05:08:17 2 Q. You were asked a question about

05:08:19 3 Pittsburgh being split earlier. Do

05:08:21 4 you remember being asked about that?

05:08:22 5 A. Yes.

05:08:23 6 Q. Did you do any analysis with

05:08:26 7 respect to the communities of interest

05:08:27 8 related to the City of Pittsburgh?

05:08:31 9 A. I did not.

05:08:32 10 Q. Did you read what has been

05:08:33 11 titled the Lamb Report authored by

05:08:35 12 Pittsburgh City Controller and

05:08:38 13 lifelong resident of the City of

05:08:43 14 Pittsburgh, Michael Lamb, that was in

05:08:48 15 the brief filed by the Senate

05:08:51 16 Democratic Caucus?

05:08:51 17 A. No, I did not.

05:08:52 18 Q. Okay.

05:08:54 19 When you look at population deviation

05:08:56 20 and you just look at that number

05:08:58 21 related to a map, can it tell you

05:09:01 22 anything about whether that map has

05:09:07 23 been optimized for partisanship?

05:09:13 24 A. No.

05:09:14 25 Q. When you look at contiguity of

05:09:15 1 a map, can it tell you anything about
05:09:16 2 whether that map as been optimized for
05:09:19 3 partisanship?

05:09:21 4 A. No.

05:09:21 5 Q. When you look at compactness of
05:09:24 6 a map, can it tell you anything about
05:09:25 7 whether that map has been optimized
05:09:29 8 for partisanship?

05:09:29 9 A. It sometimes has been used that
05:09:32 10 way in the past in the sense of, you
05:09:37 11 know, very poor compactness scores
05:09:38 12 reflecting some sort of intention.

05:09:38 13 Q. So it --- so it's been used as
05:09:40 14 --- compactness has been used as a
05:09:45 15 tool in the past to achieve partisan
05:09:45 16 optimization.

05:09:47 17 Is that fair?

05:09:47 18 A. The lack of compactness, I
05:09:51 19 guess, yes.

05:09:52 20 Q. But you agree that simply
05:09:56 21 looking at a compactness score, you
05:09:58 22 don't know, unless you look at other
05:10:00 23 factors, whether the map is being
05:10:01 24 optimized for partisanship?

05:10:06 25 A. That's correct.

05:10:06 1 Q. And looking at splits, just by
05:10:17 2 looking at splits you can't tell if
05:10:21 3 those splits have been used in a way
05:10:23 4 to optimize partisanship or not.

05:10:29 5 Correct?

05:10:29 6 A. That's correct.

05:10:35 7 Q. I'm referring you to Table 9.
05:10:37 8 I believe this is your reply report.
05:10:41 9 Just correct me if I'm mistaken about
05:10:42 10 that. It is on page 11 of the report.

05:10:44 11 A. That's correct.

05:10:45 12 Q. When we look at this, can we
05:10:47 13 learn anything about whether a map has
05:10:50 14 been optimized for partisanship?

05:10:53 15 A. I don't know about the word
05:10:56 16 optimized.

05:10:56 17 Q. So when we look at this, you
05:10:57 18 agree that some maps score higher on
05:11:07 19 the anti-majoritarian metric than
05:11:07 20 others.

05:11:18 21 Correct?

05:11:18 22 A. That's correct.

05:11:19 23 Q. And you agree that the
05:11:19 24 anti-majoritarian metric is a tool
05:11:19 25 used to understand the partisanship of

05:11:22 1 a map.

05:11:23 2 Correct?

05:11:24 3 A. That's correct.

05:11:24 4 Q. And you agree the Senate
05:11:26 5 Democratic Map Number 1 up there, it's
05:11:28 6 got three highlighted blocks showing
05:11:31 7 anti-majoritarian factors.

05:11:34 8 Correct?

05:11:35 9 A. That's correct.

05:11:36 10 Q. And why are they highlighted
05:11:38 11 red rather than highlighted blue?

05:11:40 12 A. So each of those examples is an
05:11:42 13 election where the Democratic
05:11:45 14 candidate won the statewide vote. But
05:11:48 15 under the --- sorry, the first Senate
05:11:51 16 Democratic map, the Republicans would
05:11:53 17 have won the majority of the
05:11:56 18 districts.

05:11:56 19 Q. So with respect to the Senate
05:11:58 20 Democratic map, the indicators of
05:12:02 21 ant---majoritarianis that you've
05:12:07 22 highlighted do not cut in the
05:12:20 23 direction of a Democratic advantage.

05:12:20 24 Correct?

05:12:20 25 A. That's correct.

05:12:27 1 Q. Is it possible that a map can
05:12:29 2 comply with the traditional
05:12:30 3 redistricting principles we discussed
05:12:33 4 and still be optimized for
05:12:40 5 partisanship?

05:12:40 6 A. I mean, if you --- meaning
05:12:40 7 actually you have core values on the
05:12:45 8 scores, the answer is yes.

05:12:49 9 Q. Thank you.

05:12:49 10 ATTORNEY ATTISANO:

05:12:49 11 No further questions.

05:12:49 12 JUDGE MCCULLOUGH:

05:12:54 13 Thank you, Mr. Attisano.

05:12:54 14 Petitioner Gressman, do you have
05:12:57 15 Redirect?

05:13:09 16 ATTORNEY RING-AMUNSON:

05:13:09 17 Thank you, Your Honor.

05:13:09 18 ---

05:13:09 19 REDIRECT EXAMINATION

05:13:10 20 ---

05:13:10 21 BY ATTORNEY RING-AMUNSON:

05:13:11 22 Q. Doctor DeFord, is it true that
05:13:12 23 you, in your reports, attempted to
05:13:15 24 report all metrics for all maps?

05:13:18 25 A. To the extent I could, yes.

05:13:18 1 Q. And does that mean that each
05:13:21 2 party can find its favorite nugget
05:13:21 3 somewhere in your report to point out
05:13:31 4 to the Judge?

05:13:31 5 A. That's correct.

05:13:31 6 Q. And some of the metrics on a
05:13:35 7 particular line item might favor maps
05:13:36 8 submitted by Democratic parties?

05:13:37 9 A. That's correct.

05:13:38 10 Q. And some of the metrics on a
05:13:39 11 particular line item might favor
05:13:41 12 Republican parties?

05:13:42 13 A. That's correct.

05:13:43 14 Q. So why did you not cherry pick
05:13:45 15 your presentation to focus only on the
05:13:47 16 metrics that favored the Gressman Math
05:13:52 17 and Science Petitioners map?

05:13:53 18 A. You know, I sort of of was
05:13:55 19 asked to analyze initially the
05:13:57 20 Gressman plan and then, you know, all
05:13:58 21 of the plans across sort of all the
05:14:01 22 metrics that I deemed responsive to
05:14:04 23 the criteria, and so that's what I did
05:14:06 24 and I reported the results for all of
05:14:08 25 those analyses.

05:14:10 1 Q. And if every party can pick one
05:14:13 2 specific line item or another where
05:14:16 3 they perform the best, why is it and
05:14:19 4 how were you able to develop a view
05:14:21 5 that the Gressman Math and Science
05:14:23 6 Petitioners map performs the best when
05:14:29 7 accounting for all of the criteria
05:14:31 8 together?

05:14:31 9 A. Yeah, so in particular, looking
05:14:33 10 across the criteria and observing, you
05:14:35 11 know, the best possible performance on
05:14:37 12 --- or the best performance across the
05:14:39 13 maps on splits, you know, this is
05:14:41 14 really sort of a remarkable
05:14:42 15 performance compared to the other
05:14:45 16 plans on the partisanship measures,
05:14:47 17 you know, exact population balance,
05:14:50 18 you know, sort of taken together, you
05:14:52 19 know, in my expert opinion, make the
05:14:52 20 mathematicians and scientists map the
05:14:57 21 best one.

05:14:57 22 ATTORNEY RING-AMUNSON:

05:14:57 23 Thank you. No more
05:14:58 24 questions.

05:14:58 25 JUDGE MCCULLOUGH:

05:15:00 1 Thank you. You may step
05:15:01 2 down and thank you very much,
05:15:03 3 Professor.

05:15:03 4 THE WITNESS:

05:15:04 5 Thank you.

05:15:04 6 JUDGE MCCULLOUGH:

05:15:04 7 Unless there was any
05:15:05 8 Recross. I'm sorry I didn't --- is
05:15:07 9 there.

05:15:07 10 ATTORNEY VANCE:

05:15:08 11 No.

05:15:08 12 JUDGE MCCULLOUGH:

05:15:08 13 Okay.

05:15:09 14 Then we will move on.

05:15:11 15 Thank you. We will move on. Now,
05:15:25 16 Respondent, Secretary Chapman I do not
05:15:26 17 believe has an expert for today or
05:15:33 18 does ---?

05:15:33 19 ATTORNEY WIYGUL:

05:15:34 20 Your Honor, so the
05:15:34 21 Respondents don't have a map expert
05:15:34 22 because they haven't submitted a map.
05:15:34 23 The Governor has a map expert that
05:15:35 24 he'd like to call. And I know there's
05:15:35 25 a separate issue which we discussed,

05:15:37 1 and I understand there was a
05:15:38 2 conference this morning I missed, I
05:15:38 3 apologize for that, about the
05:15:43 4 Respondents possibly calling a witness
05:15:44 5 on --- just on calendar issues. My
05:15:46 6 thought was that that might happen
05:15:49 7 tomorrow, if at all, and not at this
05:15:52 8 moment.

05:15:52 9 JUDGE MCCULLOUGH:

05:15:52 10 Right. We may not --- I
05:15:52 11 don't --- I don't think we're going to
05:15:56 12 need that, but we will talk about that
05:15:57 13 later.

05:16:00 14 ATTORNEY WIYGUL:

05:16:00 15 Okay.

05:16:00 16 JUDGE MCCULLOUGH:

05:16:01 17 You may proceed to call
05:16:01 18 your witness on behalf of Governor
05:16:03 19 Wolf.

05:16:03 20 ATTORNEY WIYGUL:

05:16:03 21 Thank you, Your Honor.
05:16:05 22 Governor Wolf calls Professor Moon
05:16:12 23 Duchin to the stand, please.

05:16:15 24 COURT CRIER TURNER:

05:16:16 25 Please raise your right

1 hand.

2 ---

3 PROFESSOR MOON DUCHIN,
4 CALLED AS A WITNESS IN THE FOLLOWING
5 PROCEEDINGS, HAVING FIRST BEEN DULY
6 SWORN, TESTIFIED AND SAID AS FOLLOWS:

05:16:25 7 ---

05:16:25 8 ATTORNEY WIYGUL:

05:16:25 9 And Your Honor, may I
05:16:27 10 just provide the witness with a
05:16:28 11 binder, if that's all right?

05:16:28 12 JUDGE MCCULLOUGH:

05:16:28 13 Is that the witness's
05:16:30 14 report?

05:16:30 15 ATTORNEY WIYGUL:

05:16:30 16 I understand it's the
05:16:30 17 witness's report and other reports as
05:16:33 18 well.

05:16:33 19 JUDGE MCCULLOUGH:

05:16:34 20 Yes.

05:16:34 21 ---

05:16:34 22 DIRECT EXAMINATION

05:16:45 23 ---

05:16:45 24 BY ATTORNEY WIYGUL:

05:16:45 25 Q. Good afternoon, Professor

05:16:47 1 Duchin. Could you please start by
05:16:48 2 just introducing yourself to the
05:16:50 3 Court, please?

05:16:50 4 A. Yes. My name is Moon Duchin.

05:16:53 5 Q. And what's your current
05:16:54 6 position?

05:16:55 7 A. I'm a professor of mathematics
05:16:57 8 and Senior Fellow in the College of
05:17:01 9 Civic Life at Tufts University.

05:17:01 10 Q. And do you have any experience
05:17:02 11 in any areas of research that are
05:17:04 12 relevant to the two reports you
05:17:06 13 prepared in this matter?

05:17:07 14 A. Yes. The main focus of my
05:17:10 15 research in recent years has been on
05:17:10 16 techniques to analyze redistricting
05:17:18 17 and systems of election.

05:17:18 18 Q. And have you published in
05:17:19 19 peer-reviewed articles in the area of
05:17:21 20 redistricting?

05:17:21 21 A. Yes, quite a few at this point
05:17:23 22 appearing in places like the Election
05:17:27 23 Law Journal, Political Analysis,
05:17:32 24 Statistics in Public Policy and so on.

05:17:32 25 Q. Outside of that strictly

05:17:35 1 academic work, do you have any other
05:17:37 2 experience where you assess the
05:17:39 3 characteristics --- characteristics of
05:17:40 4 district maps?

05:17:41 5 A. I do. In this cycle I have
05:17:44 6 worked with various line-drawing
05:17:47 7 bodies such as redistricting
05:17:47 8 commissions, independent and
05:17:51 9 bipartisan commissions around the
05:17:52 10 country which have brought me into
05:17:56 11 call balls and strikes as I see it and
05:17:59 12 try to put plans in the context in
05:18:01 13 terms of metrics trying to understand
05:18:03 14 the alternatives and the political
05:18:06 15 geography.

05:18:07 16 Q. I would like to turn now to the
05:18:09 17 reports in this matter. Generally
05:18:10 18 speaking, what were you asked to do?

05:18:11 19 A. I was asked in this matter to
05:18:13 20 look at a collection of congressional
05:18:17 21 plans for Pennsylvania, to compare
05:18:20 22 them. Ultimately I compared 13 plans,
05:18:24 23 but also performed what has been
05:18:27 24 called an ensemble analysis, what I
05:18:30 25 call an ensemble analysis. My main

05:18:34 1 ensemble consists of 100,000
05:18:38 2 alternative plans that follow the ---
05:18:39 3 the rules and priorities of
05:18:41 4 Pennsylvania redistricting, so I
05:18:43 5 suppose you could say I compared
05:18:52 6 100,013 plans.

05:18:53 7 Q. And we've heard a lot in this
05:18:53 8 case so far about traditional or
05:18:53 9 neutral redistricting principles.
05:18:53 10 You heard that testimony?

05:18:53 11 A. Yes.

05:18:54 12 Q. Did you evaluate the maps in
05:18:55 13 this case under those principles?

05:18:56 14 A. I did.

05:18:57 15 Q. Okay.

05:18:57 16 And what do you understand the
05:19:00 17 term traditional districting
05:19:03 18 principles to mean?

05:19:05 19 A. So in my view, usually there's
05:19:07 20 a sort big six. So we talk about
05:19:09 21 population equality under one person,
05:19:12 22 one vote, we talk about minority
05:19:14 23 opportunity to elect under the Voting
05:19:17 24 Rights Act of 1965 and the
05:19:20 25 Constitution.

05:19:20 1 There are compactness and
05:19:22 2 contiguity, there's respect for
05:19:24 3 political boundaries and also respect
05:19:27 4 for communities of interest. Those
05:19:29 5 round out the most important of the
05:19:31 6 most typically considered six, and
05:19:34 7 there are others such as least change
05:19:36 8 and incumbency considerations and so
05:19:40 9 on that are often in play.

05:19:43 10 Q. We've also heard quite a bit
05:19:44 11 today about the conduct of
05:19:46 12 partisanship fairness. Did you
05:19:46 13 evaluate the maps at issue in this
05:19:47 14 case for partisan fairness?

05:19:47 15 A. I did. And I took that to be a
05:19:47 16 major area of interest in comparing
05:19:48 17 the maps.

05:19:48 18 Q. And what do you understand the
05:19:50 19 term partisan fairness to mean?

05:19:50 20 A. Broadly, in terms of partisan
05:19:50 21 fairness, I've been talking about
05:20:07 22 concepts like vote dilution. The idea
05:20:11 23 is that votes should weigh as much,
05:20:11 24 they should have as much weight, power
05:20:14 25 and value, regardless of how they're

05:20:16 1 aligned or how they're placed. And
05:20:17 2 that includes, in particular, votes
05:20:19 3 cast for members of different parties.
05:20:21 4 So the partisan fairness broadly is
05:20:24 5 about giving votes equal weight,
05:20:31 6 irrespective of their party limit.

05:20:33 7 Q. And you said you analyzed the
05:20:34 8 13 maps that were submitted in this
05:20:36 9 case. Is it true in your opening
05:20:38 10 report you focused on three, the
05:20:39 11 Governor's plan, HB-2146 or the plan
05:20:44 12 passed out at Pennsylvania House and
05:20:46 13 what your report referred to as the
05:20:48 14 Citizens plan?

05:20:49 15 A. That's correct.

05:20:49 16 Q. And just to be clear, by
05:20:51 17 Citizens plan because of the
05:20:52 18 nomenclature you're referring to the
05:20:56 19 draw of the lines in the Amicus plan.

05:20:58 20 Is that correct?

05:20:58 21 A. That's right. I would like to
05:20:59 22 point out, it was noted in one of the
05:21:00 23 --- at least one of the response
05:21:03 24 briefs that their plan had been
05:21:05 25 updated several times in January, and

05:21:10 1 so in the report I look at, a January
05:21:13 2 draw of the lines plan, but I'm also
05:21:14 3 prepared to discuss the update. I
05:21:19 4 compared them.

05:21:19 5 Q. Okay.

05:21:20 6 Great. Great?

05:21:20 7 And so you looked at those
05:21:22 8 three plans initially and then your
05:21:23 9 response report looked at the balance
05:21:24 10 of the plans.

05:21:24 11 Is that right?

05:21:25 12 A. That's right.

05:21:25 13 Q. So after conducting your
05:21:28 14 analysis did you reach any conclusions
05:21:29 15 to a reasonable degree of professional
05:21:31 16 certainty about the various maps
05:21:33 17 conformance to what we called the
05:21:35 18 traditional redistricting principles?

05:21:38 19 A. I --- I did. I analyzed that
05:21:40 20 in some detail.

05:21:41 21 Q. And --- and generally speaking,
05:21:42 22 what were those conclusions?

05:21:43 23 A. In general, the plans submitted
05:21:45 24 that are in consideration for the
05:21:49 25 Court form quite well across a range

05:21:51 1 of different metrics, but that's not
05:21:52 2 to say that you can't make some
05:21:55 3 distinctions if you're looking to make
05:21:59 4 tiers of adherence to the traditional
05:22:02 5 principles.

05:22:03 6 Q. And let's --- can we pull up
05:22:05 7 Exhibit 1 to your opening report,
05:22:06 8 please. That's page eight, Table 1.
05:22:09 9 And this addresses the principle
05:22:10 10 population balance.

05:22:12 11 Is that correct?

05:22:12 12 A. That's right.

05:22:13 13 Q. What conclusions did you reach
05:22:15 14 with regard to this principle?

05:22:17 15 A. That all plans --- in this
05:22:22 16 case, the initial three --- but
05:22:24 17 ultimately all 13 plans are quite
05:22:27 18 tightly population balanced with
05:22:28 19 respect to their --- to the relevance
05:22:30 20 basis of population that they
05:22:33 21 considered.

05:22:33 22 Q. And then there's also a table
05:22:35 23 about prisoner adjusted numbers.

05:22:37 24 Can you just explain what that is?

05:22:39 25 A. Absolutely. So there are

05:22:40 1 actually three data sets in play, the
05:22:47 2 census PL 94171, as it's called,
05:22:48 3 that's the raw decennial data release.
05:22:54 4 And in the State of Pennsylvania the
05:22:59 5 LRC released two data sets afterwards.
05:22:59 6 One that many people call LRC-1,
05:23:02 7 corrects some boundaries and what you
05:23:04 8 might call some labeling errors from
05:23:07 9 the census bureau, but it's very
05:23:10 10 similar. And a second ORC 2 that
05:23:13 11 reallocates incarcerated people as
05:23:19 12 best as possible to their communities
05:23:21 13 of origin.

05:23:21 14 Most of the plans are balanced
05:23:21 15 with respect to the first data set to
05:23:25 16 the raw census data and LRC-1 which
05:23:25 17 agree. But in particular the plan
05:23:25 18 submitted by Khalif Ali, et al. is
05:23:25 19 balanced with respect to the prisoner
05:23:35 20 adjusted data.

05:23:35 21 Q. And so you show what the
05:23:36 22 deviation would be for these three
05:23:38 23 plans under that data set.

05:23:39 24 Is that correct?

05:23:40 25 A. Yes.

05:23:47 1 Q. Okay.

05:23:47 2 Now, we've also heard a lot
05:23:47 3 about contiguity, I believe the
05:23:47 4 testimony so far has been all the
05:23:47 5 plans at issue are contiguous?

05:23:47 6 Do you agree with that?

05:23:53 7 A. I do.

05:23:53 8 Q. So let's move on to compactness
05:23:53 9 and can we pull up your opening
05:23:56 10 report, page nine, Table 3, and
05:23:57 11 Exhibit 2 --- excuse me, and your
05:23:58 12 response report, page two. Maybe
05:23:58 13 juxtapose those, if we can.

05:24:06 14 We've heard a lot about
05:24:09 15 compactness in this case. Can you
05:24:11 16 just say generally how you would
05:24:12 17 describe that metric?

05:24:12 18 A. Sure. Maybe a family of
05:24:17 19 metrics. Compactness is one of the
05:24:18 20 areas of my specialization. It's what
05:24:22 21 got me into thinking about
05:24:24 22 redistricting in the first place. And
05:24:26 23 here I've concluded the five
05:24:28 24 different, what I call, contour-based
05:24:33 25 measures that were referenced by the

05:24:34 1 Supreme Court in the League of Women
05:24:36 2 Voters case.

05:24:37 3 All the plans in 2018 had to
05:24:39 4 submit the scores of those five
05:24:41 5 metrics. And then there's another one
05:24:42 6 called block cut edges, which is a
05:24:45 7 discreet measure that takes the units
05:24:48 8 into account, but without going into
05:24:48 9 great depth, rather than choosing a
05:24:53 10 metric, I've as you'll see in many of
05:24:54 11 the expert treatments, and as you'll
05:24:56 12 see in the way I treat other matters,
05:24:58 13 I've tried to report all the ones I
05:25:01 14 think are of interest.

05:25:02 15 Q. And what conclusions do you
05:25:04 16 draw about the relative performance of
05:25:07 17 the various maps under these different
05:25:09 18 compactness scores?

05:25:11 19 A. That the maps are quite good
05:25:15 20 across the board, but that you can
05:25:17 21 still see some that are better. And
05:25:19 22 the Governor's plan, in particular, is
05:25:22 23 highly compact. It's the most compact
05:25:26 24 in several of these measures. It's
05:25:27 25 one of the two or three most compact

05:25:30 1 in perhaps most or all of the
05:25:32 2 measures.

05:25:33 3 So broadly speaking, I agree
05:25:35 4 with the experts who have spoken
05:25:37 5 before me, who have said that the
05:25:39 6 different measures capture largely
05:25:41 7 different things, some of them are
05:25:42 8 very similar, but that I feel very
05:25:49 9 comfortable saying the Governor's plan
05:25:52 10 is particularly compact.

05:25:53 11 Q. And what about the relative
05:25:54 12 performance of the house map or
05:25:54 13 HB-2146 with respect to compactness?

05:25:59 14 A. It's certainly one of the least
05:26:01 15 compact of these.

05:26:01 16 Q. Now, we've also spoken about
05:26:05 17 political boundaries today. And can
05:26:07 18 we pull up the response report,
05:26:11 19 Professor Duchin, page two, Table 1,
05:26:12 20 please?

05:26:12 21 So can you say again, what do
05:26:14 22 you understand respecting political
05:26:16 23 boundaries to mean?

05:26:18 24 A. So respecting political
05:26:20 25 boundaries means that once you know

05:26:21 1 which the relevant units are, you
05:26:25 2 should try not split them, try to keep
05:26:28 3 them whole. And when you must split
05:26:31 4 them, you should pay attention to how
05:26:34 5 many pieces you're splitting them
05:26:34 6 into.

05:26:34 7 As you heard from Doctor Rodden
05:26:34 8 --- and I heartily agree, this will
05:26:39 9 depend heavily on which data set you
05:26:40 10 use to define your terms. So what you
05:26:44 11 see here is the county subdivision
05:26:46 12 data set from the census borough that
05:26:47 13 Doctor Rodden spoke about earlier.
05:26:50 14 That's the basis of my municipality
05:26:57 15 numbers here. And it includes cities,
05:26:58 16 towns, townships and boroughs. I did
05:26:59 17 also look at wards, that's not
05:27:00 18 reflected in these numbers.

05:27:03 19 Q. So is it fair to say to make
05:27:05 20 sure you're comparing apples and
05:27:09 21 apples you have to make sure you know
05:27:09 22 what each party or expert means by
05:27:10 23 political subdivision?

05:27:11 24 A. Absolutely. And I think when
05:27:13 25 you compare the reports, it can become

05:27:14 1 obvious if you're reading a report of
05:27:16 2 someone who has thought a lot about
05:27:18 3 these different choices and certainly
05:27:20 4 --- certainly I did think about what
05:27:22 5 the best data set was to use for
05:27:25 6 correspondence to the terms of the
05:27:26 7 constitution.

05:27:26 8 Q. And when you applied your
05:27:28 9 analysis of respect for political
05:27:30 10 subdivisions to the maps in this case,
05:27:32 11 what conclusions do you draw?

05:27:35 12 A. Really broadly, these are all
05:27:38 13 excellent on this level. Just the way
05:27:40 14 --- you know, we see so many numbers
05:27:42 15 when we look at analyses like this, so
05:27:45 16 here I would just remind you, if
05:27:47 17 you're trying to make your way around
05:27:49 18 those numbers, we're dealing with 17
05:27:52 19 district plans. And so if you think
05:27:54 20 about it, plans that split 17 and even
05:27:58 21 fewer than 17 are, you know, in that
05:28:01 22 neighborhood, those should be really
05:28:03 23 considered excellent in the context of
05:28:06 24 trying to balance population finally.
05:28:08 25 And so what you see here is that, you

05:28:11 1 know, 13 to 16 county splits is true
05:28:14 2 for most of these, and 16 to 18
05:28:18 3 municipality splits is true for most
05:28:20 4 of these. And I consider those to be
05:28:23 5 excellent.

05:28:24 6 We've heard people talking
05:28:25 7 today about absolutely minimization of
05:28:28 8 these numbers, and to that I would
05:28:29 9 just remind you it's minimization in
05:28:32 10 view of the other --- the other
05:28:34 11 properties and criteria that must be
05:28:37 12 maintained. So everyone who thinks
05:28:39 13 about these numbers understands that
05:28:41 14 there are trade-offs, and that perhaps
05:28:43 15 if you split one more county you can
05:28:46 16 get a better compactness score and so
05:28:49 17 on. So these all reflect decisions
05:28:50 18 about those trade offs.

05:28:52 19 Q. And you mentioned a range that
05:28:56 20 most of the plans were in, which I
05:28:57 21 think you described as excellent, just
05:28:57 22 to be clear is the Governor's plan
05:29:00 23 within those ranges?

05:29:01 24 A. It is. And --- and as is also
05:29:02 25 noted in some of the reports. Some of

05:29:03 1 these county splits are really quite
05:29:06 2 minor, but are listed here nonetheless
05:29:09 3 such as that example of six stray
05:29:16 4 paper in Chester County.

05:29:16 5 Q. I understand. Now, are you
05:29:18 6 aware that several other experts in
05:29:19 7 this contact have focused on many
05:29:22 8 criticize the fact that the governor
05:29:24 9 maps splits the City of Pittsburgh?

05:29:26 10 A. Yes, I did notice that was a
05:29:28 11 theme in a number of the reports.

05:29:28 12 Q. And did you have any opinions
05:29:30 13 that you want to offer about that
05:29:31 14 focus?

05:29:32 15 A. Well, just to say that there
05:29:38 16 are many things you're balancing, as
05:29:39 17 I've already said, and particularly
05:29:40 18 when it comes to city splits, I think
05:29:40 19 that --- one thing that's called to
05:29:52 20 mind for me is a story from an
05:29:53 21 interview that I actually conducted
05:29:57 22 for a book that's in press with
05:30:01 23 Professor Nate Persily, who is a
05:30:01 24 longstanding and highly respected
05:30:02 25 redistricting expert. Indeed he's the

05:30:05 1 line drawer who drew the remedial plan
05:30:09 2 that we've all been praising today.

05:30:09 3 Q. In 2018?

05:30:12 4 A. In 2018 in Pennsylvania for the
05:30:15 5 court --- the Supreme Court of
05:30:15 6 Pennsylvania. So the plan that we're
05:30:17 7 using as the benchmark. And in this
05:30:22 8 interview Professor Persily talks
05:30:23 9 about having drawn lines for many
05:30:24 10 decades, including the State of New
05:30:26 11 York. And he gives a colorful example
05:30:33 12 of Buffalo, where he says, you know,
05:30:33 13 he sat down to draw a great plan, he
05:30:33 14 was looking at all the metrics, and he
05:30:35 15 saw that Buffalo had been split and
05:30:36 16 that he didn't have to split it.

05:30:37 17 And in fact, the way he
05:30:38 18 described it in the interview, he
05:30:40 19 could drive this really nice round
05:30:45 20 district around Buffalo, keeping it
05:30:45 21 whole and getting a great compactness
05:30:45 22 score and he was patting himself on
05:30:45 23 the back over that.

05:30:49 24 And then when the plan came out
05:30:50 25 to the public the news stories, the

05:30:52 1 headline was Buffalo loses district,
05:30:57 2 because having had two representatives
05:30:59 3 before and now they would have only
05:31:02 4 one. So what he thought was just a
05:31:04 5 win-win in terms of the metrics
05:31:08 6 actually turned out to be regarded as
05:31:11 7 getting a little bit less
05:31:11 8 representation to Buffalo.
05:31:13 9 That's not to say that you should
05:31:14 10 always split cities, that's to say
11 that there are also community of
12 interest considerations. And I
13 believe we've just heard about an
14 example in --- please correct me,
15 because there are many parties, but I
16 think it was the senate, Democratic
17 caucus brief of the city of controller
18 from Pittsburgh testifying that a
05:31:15 19 two-district split for Pittsburgh
05:31:18 20 could be a good choice in view of
05:31:18 21 communities of interest. So that was
05:31:18 22 --- sorry that was a bit of a long
05:31:18 23 answer.
05:31:18 24 But all to say, I think these
05:31:42 25 are all reasonable choices. Some of

05:31:46 1 the reports say that the Governor's
05:31:49 2 plan split of Pittsburgh is an obvious
05:31:52 3 Democratic gerrymandering ploy and
05:31:52 4 some reports say it's an obvious ploy
05:31:54 5 to get better compacting scores. I
05:31:57 6 just think there are good reasons as
05:31:59 7 well why a city split, particularly
05:32:02 8 into two districts that can comport
05:32:06 9 with the preferences of the City might
05:32:07 10 be the best for --- for
05:32:08 11 representational goals.

05:32:08 12 Q. Now, in that context of what
05:32:12 13 you just said, you mentioned
05:32:12 14 communities of interest, which you
05:32:14 15 also spoke about earlier. Could we
05:32:17 16 bring up opening report, page 11,
05:32:21 17 Figure 2, and can you start by
05:32:22 18 explaining about the principle of
05:32:24 19 communities of interest?

05:32:25 20 A. Yes. So the idea there in the
05:32:26 21 communities of interest norm is that
05:32:29 22 we should identify geographical areas
05:32:34 23 where the residents have shared
05:32:35 24 interests that are relevant to their
05:32:37 25 representation. So this could be

05:32:38 1 shared history, shared economics,
05:32:40 2 shared culture, many other examples.
05:32:44 3 And the principle says you should be
05:32:48 4 attentive to communities of interest,
05:32:50 5 especially in view of the example I
05:32:52 6 just gave.

05:32:53 7 It doesn't always mean a
05:32:55 8 community should be held whole.
05:32:58 9 Sometimes it's more effectively split.
05:32:58 10 But they should be kind of top of mind
05:33:00 11 for the line drawers, as they draw.
05:33:02 12 And for the plans that I was
05:33:04 13 considering in the initial report, I
05:33:07 14 know that the Governor's plan had a
05:33:09 15 public portal, collected hundreds of
05:33:12 16 submissions from the public about
05:33:15 17 their communities. The Citizens plan
05:33:17 18 was based on a mapping competition,
05:33:19 19 which ---.

05:33:19 20 Q. Again, this is the Draw the
05:33:22 21 Lines plan, just to be clear?

05:33:22 22 A. Yes. Thank you. Several of
05:33:23 23 them do use the word citizens. So the
05:33:28 24 Draw the Lines plan, which I've called
05:33:28 25 Citizens plan was the output of a

05:33:31 1 mapping competition that had hundreds
05:33:35 2 even maybe thousands of entries.

05:33:36 3 The House plan has its own
05:33:38 4 really nice origin story, in my
05:33:40 5 opinion. It's derived from a map
05:33:41 6 drawn from a map drawn Susan Amanda
05:33:44 7 Holt, engaged --- highly engaged
05:33:46 8 Pennsylvanian who really has taken a
05:33:49 9 --- has done a great job and taken a
05:33:51 10 great interest in mapping. My
05:33:53 11 understanding, which is not informed
05:33:55 12 by any special knowledge, but my
05:33:57 13 understanding from the coverage is
05:33:58 14 that that was drawn primarily in
05:34:01 15 isolation and in view of the metrics.
05:34:04 16 And I think that's a little bit
05:34:06 17 reflected. Here I've compared how the
05:34:08 18 three plans split up Philadelphia. So
05:34:12 19 Philadelphia city and county is
05:34:14 20 outlined in red in the plans, and I
05:34:16 21 think that you get divisions of the
05:34:20 22 City that are more logical from the
05:34:22 23 point of view of the COI testimony in
05:34:24 24 the Governor's plan and the Citizens
05:34:26 25 plan.

05:34:27 1 The Holt derived House map, you
05:34:30 2 can see a little sort of chomp into
05:34:34 3 Philadelphia in the north. What you
05:34:36 4 can't maybe see at this resolution is
05:34:39 5 that towards the south, that District
05:34:40 6 actually enters Philadelphia in two
05:34:43 7 different places. I don't --- I don't
05:34:46 8 know of any kind of community oriented
05:34:48 9 justification for the way that that
05:34:50 10 split is designed.

05:34:51 11 Q. I'd like to ask you about
05:34:53 12 another redistricting principle, which
05:34:54 13 is the least change principle.

05:34:56 14 Are you aware of that one?

05:34:58 15 A. Yes.

05:34:58 16 Q. And could you describe that for
05:34:59 17 the Court, please?

05:35:00 18 A. Yes. So least change and
05:35:05 19 associated metrics look to measure the
05:35:05 20 degree of a plan's resemblance to
05:35:07 21 another another plan. And in this
05:35:08 22 case to that benchmark plan drawn by
05:35:16 23 Professor Persily that I just
05:35:17 24 mentioned. And it's more
05:35:18 25 straightforward to measure this when

05:35:20 1 you have the same number of districts,
05:35:22 2 but as you heard from Doctor Rodden
05:35:24 3 earlier, you can still do that even
05:35:26 4 though the number of districts has
05:35:29 5 dropped just by looking for the best
05:35:29 6 matching. And I did look at that
05:35:31 7 metric in my report.

05:35:32 8 Q. And could we pull up opening
05:35:34 9 report, page ten, Table 4, please.
05:35:39 10 And I'll ask you, Professor Duchin,
05:35:40 11 does this represent the results of
05:35:40 12 your analysis on least change, at
05:35:42 13 least in your initial report?

05:35:43 14 A. That's right. This shows the
05:35:44 15 best matching of the new districts to
05:35:47 16 the amount of displacement, which is
05:35:49 17 really quite similar to the metric
05:35:52 18 Doctor Rodden described.

05:35:52 19 Q. And what does that show in
05:35:53 20 terms of the relative performance of
05:35:55 21 these three maps?

05:35:56 22 A. Of these three, the Governor's
05:35:59 23 plan is the most like the --- the
05:36:00 24 current plan, the remedial plan from
05:36:02 25 2018. I did later look at the rest of

1 the maps and I quickly tried to
2 compare my numbers to Doctor Rodden's
3 when they were on screen, and they ---
4 and they agree. So it is the case
5 that the Carter plan is the closest to
6 the remedial plan.

05:36:18 6
05:36:18 7 Q. And let me just Zoom out here
05:36:20 8 for a moment and ask why is minimizing
05:36:22 9 changes from the old map, in this case
05:36:24 10 the 2018 remedial plan, why is that
05:36:27 11 redistricting value?

05:36:28 12 A. If you believe that the old
05:36:29 13 plan is a good one, if you believe
05:36:32 14 that the old plan has shown itself to
05:36:36 15 perform in ways that are fair, if you
05:36:38 16 believe that the old plan represents
05:36:41 17 the principles that you're trying to
05:36:44 18 embody, then it does make some sense
05:36:45 19 that you try to look a lot like it.
05:36:47 20 Although I think this would clearly go
05:36:50 21 lower order priority than those
05:36:52 22 traditional principles that we
05:36:54 23 discussed in the first group.

05:36:57 24 Q. Can we pull up opening report
05:37:00 25 page ten, Table 5, please. And I want

05:37:03 1 to ask you, this --- this table
05:37:03 2 addresses the principal incumbent
05:37:08 3 pairing, and what does that principle
05:37:09 4 focus on?

05:37:09 5 A. So that looks at the question
05:37:11 6 of whether --- when you take the home
05:37:13 7 addresses of the incumbents for the
05:37:15 8 office that you're analyzing, have you
05:37:15 9 drawn the districts in a way that they
05:37:15 10 contain multiple incumbents.

05:37:15 11 This is sometimes colorfully
05:37:25 12 called double bunking. I really love
05:37:27 13 that image. It's like a fight over a
05:37:28 14 bunk bed and the idea these incumbents
05:37:31 15 will have to face each other if they
05:37:34 16 are planning to run for re-election in
05:37:34 17 a state that requires residency in the
05:37:37 18 district.

05:37:37 19 Q. And what conclusions, if any,
05:37:39 20 did you draw about the various maps
05:37:41 21 under the incumbent pairing principle?

05:37:44 22 A. Well, just from basic math,
05:37:45 23 we're going to have to compare some
05:37:47 24 incumbents to go down from 18 to 17
05:37:50 25 districts, so you'll need at least one

05:37:53 1 district that has multiplicity. And
05:37:53 2 these three plans all have two such
05:38:00 3 districts. One thing that I'll note
05:38:01 4 that is that it's my understanding
05:38:03 5 that District 5 and the Governor's
05:38:05 6 plan compares two Democratic
05:38:07 7 incumbents.

05:38:08 8 Just for the record, in my
05:38:10 9 view, when I'm trying to assess
05:38:12 10 whether a plan is a gerrymander for
05:38:15 11 one party, I think it would avoid
05:38:17 12 pairing the incumbents of that party.
05:38:18 13 So to me, this is a sign that this is
05:38:21 14 not a Democratic gerrymander plan.

05:38:24 15 Q. So if we take all the
05:38:25 16 traditional redistricting principles
05:38:26 17 that you considered, what conclusions
05:38:28 18 overall, did you draw about the
05:38:30 19 Governor's plan in relation to the
05:38:31 20 other plans before the Court?

05:38:32 21 A. I think it's really an
05:38:34 22 excellent plan on the grounds of the
05:38:35 23 traditional principles. It's one of
05:38:38 24 the very best. In my view it's
05:38:43 25 extremely compact. It is economical

05:38:46 1 in terms of political boundary splits
05:38:48 2 and the splits that it is has have a
05:38:51 3 good story. I find it to do well by
05:38:54 4 the likes of incumbent pairing and
05:38:56 5 lease change across the board. It's
05:38:57 6 an excellent plan on traditional
05:39:00 7 districting principles.

05:39:00 8 Q. I want to move on now from
05:39:03 9 traditional districting principles to
05:39:07 10 partisan fairness. That was one of
05:39:09 11 issues that you covered in your
05:39:10 12 reports.

05:39:10 13 Correct?

05:39:10 14 A. Yes.

05:39:11 15 Q. Okay.

05:39:11 16 And you compared the Governor's
05:39:12 17 maps with other maps, and specifically
05:39:12 18 the House map HB-2154 with partisan
05:39:20 19 fairness?

05:39:20 20 A. 2146, I think, if I have that
05:39:20 21 right? It's like drilled into my head
05:39:22 22 at this point

05:39:22 23 Q. Thank you. I will say the
05:39:23 24 House map so I won't get confused.

05:39:25 25 A. Yes, I did compare those.

05:39:28 1 Q. And I understand there are a
05:39:30 2 lot of different ways to talk about
05:39:30 3 partisan fairness. I think we've
05:39:31 4 already heard that, but in your report
05:39:33 5 we talked about a close votes, close
05:39:35 6 seats principle.

05:39:36 7 Can you just explain what that
05:39:37 8 means?

05:39:38 9 A. You're hearing a lot of
05:39:39 10 agreement from the experts for the
05:39:42 11 Court so far, and I think that should
05:39:44 12 be a good sign, that when you are
05:39:46 13 thinking about the small D Democratic
05:39:51 14 functioning of a plan, that is you're
05:39:53 15 thinking about how well it upholds the
05:40:00 16 norms and ideals of representative
05:40:01 17 democracy. You really want to see
05:40:02 18 that the plan has the ability to
05:40:06 19 translate more votes into more seats.
05:40:08 20 That's just bedrock principle. And so
05:40:08 21 I think I have a ---.

05:40:10 22 Q. I'm sorry, can you pull up
05:40:13 23 opening report, page 14, Figure 4,
05:40:14 24 please?

05:40:14 25 A. So hopefully, this plot isn't

05:40:17 1 too busy, but I think it has a lot of
05:40:20 2 information that I want to help
05:40:22 3 visualize. I'm a very geometric
05:40:22 4 thinker, so I like pictures. What I'm
05:40:27 5 saying is that I think we all broadly
05:40:28 6 agree that a plan that consistently
05:40:31 7 converts a majority of votes for one
05:40:39 8 party to a majority of seats for the
05:40:41 9 other party, I think we would agree,
05:40:43 10 broadly that that is unfair.

05:40:44 11 And so I've marked that here
05:40:45 12 with these quadrants and these
05:40:45 13 evocative Xs, because I thought a
05:40:53 14 skull and crossbones might be over the
05:40:53 15 top. But these are kind of no-go
05:40:55 16 zones in a sense. If you're spending
05:40:58 17 too much time in these quadrants, then
05:41:01 18 the map should really be scrutinized
05:41:02 19 very closely. And if it's possible to
05:41:03 20 do better, you should do better.

05:41:06 21 I guess while this is up I will
05:41:09 22 mention, in the other two quadrants,
05:41:13 23 the ones that are conducive to
05:41:15 24 majority rules, you know, reasonable
05:41:17 25 people can advance different norms

05:41:20 1 about what would be the best place for
05:41:21 2 data points to fall.

05:41:24 3 Should the vote share roughly
05:41:26 4 equal the C share, that's
05:41:28 5 proportionality, and I've marked that
05:41:31 6 in the reply. Should you have equal
05:41:33 7 numbers of wasted votes within a few
05:41:36 8 percentage points that are assigned,
05:41:37 9 that is the band that I've marked as
05:41:39 10 efficiency gap. Other people have
05:41:43 11 advanced other ideas about curves and
05:41:46 12 symmetry, but this is a zone in which
05:41:49 13 you have a plan that's performing well
05:41:53 14 by the likes of majority rules.

05:41:55 15 And I guess while this is up
05:41:57 16 --- and I'll be brief. I'll say that
05:41:59 17 close votes, close seats, we've also
05:41:59 18 heard about from multiple experts.
05:42:01 19 And that says if you have elections
05:42:03 20 that are close to 50 percent vote
05:42:05 21 share for the parties you like those
05:42:07 22 to give close to equal representation,
05:42:09 23 so if you're near 50 percent
05:42:16 24 horizontally you don't want to
05:42:16 25 consistently miss that bullseye by

05:42:18 1 always deviating to the north and
05:42:19 2 south. That would be a sign that
05:42:21 3 you're converting close voting to
05:42:23 4 consistent partisan advantage.
05:42:23 5 Q. And did you prepare an
05:42:25 6 animation to illustrate how the
05:42:27 7 analysis you just described would
05:42:28 8 apply to the various maps at issue in
05:42:30 9 this case?

05:42:31 10 A. I did. And I --- maybe this
05:42:34 11 will help wake us up at this point.

05:42:34 12 ATTORNEY WIYGUL:

05:42:36 13 And Your Honor, if we
05:42:37 14 could call up what we had pre-marked
05:42:39 15 for our own purposes, Exhibit 17. I
05:42:40 16 sent this around to other Counsel
05:42:42 17 earlier today. It's just an animation
05:42:42 18 that derives from the analysis in
05:42:57 19 this --- in Professor Duchin's report.

05:42:57 20 JUDGE MCCULLOUGH:

21 Okay. Hold on.

22 ATTORNEY HIRSCH:

23 Your Honor, I would like
24 to lodge a conditional objection here.
25 We received ---.

JUDGE MCCULLOUGH:

Can you state your name,
please.

ATTORNEY HIRSCH:

Sam Hirsch on behalf of
the Gressman Petitioners. We received
a set of exhibits during the course of
this afternoon electronically, but
they were not part of the five o'clock
expert report filed yesterday. And
under the extraordinary time sequence
here, I don't know if they had these
materials and didn't include them in
their five o'clock report or if they
developed them after they saw
everybody else's five o'clock report.

But if these additional
exhibits are going to come into
evidence, I would ask that we have a
chance, the two sets of Petitioners to
rebut with our experts anything that
comes out that's in these new exhibits
that we have not seen or studied at
this point.

JUDGE MCCULLOUGH:

05:43:35 1 Is this being submitted
05:43:37 2 as part of your expert report?

05:43:37 3 ATTORNEY WIYGUL:

05:43:38 4 Your Honor, I think this
05:43:38 5 is a demonstrative type exhibit to
05:43:42 6 further --- to further illustrate for
05:43:43 7 the Court the analysis that the expert
05:43:44 8 has employed and disclosed in her
05:43:46 9 report. It's a further illustration.

05:43:47 10 JUDGE MCCULLOUGH:

05:43:47 11 Hold on.

05:43:51 12 ATTORNEY MORGAN:

05:43:53 13 Your Honor, Robert
05:43:53 14 Tucker on behalf of House Republican
05:43:54 15 Intervenors, we were going to lodge
05:43:55 16 the same objection to these exhibits,
05:43:56 17 that we don't believe they should come
05:43:58 18 in as exhibits as they were not timely
05:44:01 19 disclosed by the five o'clock deadline
05:44:04 20 yesterday. Thank you.

05:44:04 21 ATTORNEY WIYGUL:

05:44:04 22 Your Honor, I'm sorry.
05:44:05 23 Would the Court like me to address
05:44:07 24 that.

05:44:07 25 JUDGE MCCULLOUGH:

05:44:08 1 Nope. There's another
05:44:09 2 crier standing.

05:44:09 3 ATTORNEY VOSS:

05:44:11 4 Joshua Voss for the
05:44:11 5 Congressional Intervenors. Your Honor
05:44:11 6 I've been in court all day with my
05:44:13 7 phone off. So if this was distributed
05:44:13 8 via email, you know, I'm honoring the
05:44:13 9 Court's rule. I haven't seen it. So
05:44:13 10 I have to lodge an objection. I
05:44:13 11 haven't seen this. I can't prepare
05:44:21 12 for it. It's --- it's prejudicial at
05:44:27 13 this point.

05:44:27 14 JUDGE MCCULLOUGH:

05:44:27 15 Okay.

05:44:27 16 Counsel, no one received
05:44:28 17 it by five o'clock yesterday. I know
05:44:28 18 you're saying it's demonstrative, but
05:44:32 19 Counsel hasn't even had a chance to
05:44:33 20 review it.

05:44:34 21 I'm a little concerned.
05:44:35 22 You may not move it into evidence, but
05:44:37 23 you're going to make it part of the
05:44:39 24 evidentiary record by examining your
05:44:42 25 witness on the basis of it. And I

05:44:44 1 have three counsels standing up
05:44:47 2 representing three different parties
05:44:48 3 objecting to the fact that they didn't
05:44:50 4 even get a chance to review it.

05:44:53 5 Is this something that is
05:44:55 6 necessary for you to use today since
05:44:59 7 it wasn't produced by five o'clock
05:45:01 8 yesterday?

05:45:02 9 ATTORNEY WIYGUL:

05:45:02 10 Well, I think, Your
05:45:03 11 Honor, it's an animation --- it's kind
05:45:07 12 of an animation over time of a still
05:45:07 13 that we did have in the report.

05:45:10 14 JUDGE MCCULLOUGH:

05:45:10 15 Well, you're making it
05:45:11 16 sound really pretty and fun, but the
05:45:13 17 substance of it can be --- can go to
05:45:16 18 the substance of this case. And I
05:45:19 19 think that the fact that it wasn't
05:45:20 20 provided to counsel by five o'clock
05:45:23 21 yesterday and you are examining your
05:45:24 22 report on it, if you cannot use it, it
05:45:28 23 would be better to move on.

05:45:31 24 ATTORNEY WIYGUL:

05:45:31 25 Okay.

05:45:32

1

JUDGE MCCULLOUGH:

05:45:32

2

I mean, you state your

05:45:33

3

position. If you feel you must use

05:45:34

4

it, go ahead, but then we're going to

05:45:37

5

lose time for counsel to now review

05:45:39

6

something that they didn't get by

05:45:43

7

five o'clock yesterday, and then we're

05:45:44

8

going to have to wait just, you know,

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9

on the Cross Examination. We can do

05:45:47

10

it if you tell me it's very important

05:45:53

11

to your case.

05:45:54

12

ATTORNEY WIYGUL:

05:45:54

13

Your Honor, let me see

05:45:55

14

if I can rely on other materials.

05:45:57

15

JUDGE MCCULLOUGH:

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16

I think that would be

05:45:58

17

great.

05:45:59

18

ATTORNEY WIYGUL:

05:45:59

19

I appreciate the Court's

05:46:01

20

concern.

05:46:01

21

JUDGE MCCULLOUGH:

05:46:01

22

Thank you.

05:46:01

23

THE WITNESS:

05:46:01

24

05:46:02

25

Would it be helpful to

05:46:04 1 clarify what's in it or not?

05:46:07 2 ATTORNEY WIYGUL:

05:46:07 3 We're not going to use
05:46:08 4 the animations at the moment.

05:46:12 5 JUDGE MCCULLOUGH:

05:46:13 6 Sure.

05:46:14 7 ATTORNEY WIYGUL:

05:46:14 8 If the Court would just
05:46:14 9 give me one second in light of that to
05:46:15 10 find ---.

05:46:15 11 JUDGE MCCULLOUGH:

05:46:15 12 Sure. Take your time.

05:46:15 13 Well, don't take too much time,

05:46:15 14 though. Whatever you need.

05:46:15 15 THE WITNESS:

05:46:15 16
05:46:16 17 This is the same
05:46:17 18 picture.

05:46:20 19 BY ATTORNEY WIYGUL:

05:46:22 20 Q. Thank you. This is
05:46:24 21 essentially, is it fair to say, a 2D
05:46:24 22 version of hat the animation was, at
05:46:24 23 least in part?

05:46:24 24 A. This is the identical picture
05:46:26 25 that is drawn in the animation.

05:46:28 1 Q. And what does this illustrate?

05:46:30 2 A. Great. Okay.

05:46:32 3 So let's see. Actually, could
05:46:38 4 we rewind one moment since we had that
05:46:38 5 intervening discussion and just go
05:46:39 6 back ever so briefly to that last plot
05:46:43 7 of the seats votes space?

05:46:47 8 Great.

05:46:47 9 So this just sets up the next
05:46:49 10 picture. So this is exactly what
05:46:50 11 you'll see. So you have the votes for
05:46:53 12 Republicans in the horizontal
05:46:55 13 direction and the seats for
05:46:56 14 Republicans in the vertical direction.
05:47:00 15 And the way that I propose that we
05:47:01 16 understand a plan is we look at how it
05:47:06 17 converts for votes, how it converts
05:47:08 18 votes to seats.

05:47:10 19 And so that means over all the
05:47:10 20 elections in the dataset, which are a
05:47:12 21 series of observations from recent
05:47:14 22 actual elections in Pennsylvania, I'm
05:47:19 23 going to plot one point for every
05:47:19 24 election. So you should maybe think
25 about this like a kind of paint ball

1 plot that shows you aiming at that
2 target for close elections, how do you
3 do? Do you come close to hitting that
4 target? Great.

05:47:32 5 So now we can go forward to the
05:47:35 6 still image that compares the plots,
05:47:38 7 and I will tell you --- excellent.
05:47:40 8 Thank you so much. So these are the
05:47:43 9 two plans that the Court considered in
05:47:46 10 2018. On the left is the 2011 enacted
05:47:49 11 plan. So this was passed into law in
05:47:49 12 the usual course of post-dicennial
05:47:57 13 census redistricting. And these are
05:47:58 14 the dataset of 12 elections that I've
05:48:02 15 considered. So this is all the
05:48:04 16 statewide non-judicial elections going
05:48:08 17 back to 2014.

05:48:10 18 And for those elections you see
05:48:12 19 a lot of them that have roughly equal
05:48:14 20 vote share for the two major parties.
05:48:16 21 In the horizontal direction, they're
05:48:19 22 pretty close to even. Not always but
05:48:21 23 much of the time.

05:48:22 24 And what you see about the
05:48:23 25 enacted plan is that it is

05:48:26 1 consistently converting even voting to
05:48:28 2 a heavily Republican representational
05:48:32 3 advantage. And below --- I've just
05:48:34 4 traced that out. That's all the
05:48:36 5 animation was going to show you is how
05:48:36 6 the picture below traces out the
05:48:36 7 points above, nothing else.

05:48:42 8 So you can see from that shape
05:48:43 9 that if your aim is for the bullseye,
05:48:43 10 you're just missing. And you're
05:48:50 11 missing in an always Republican
05:48:50 12 direction.

05:48:50 13 By contrast, the remedial plan
05:48:52 14 that the Court ordered and adopted
05:48:54 15 hits the bullseye. It really does
05:48:57 16 quite well. And when I've outlined it
05:49:00 17 in the same way that's captured in the
05:49:02 18 picture below. And so this shows you
05:49:04 19 several things. It shows you that the
05:49:06 20 remedial plan converts closed votes to
05:49:10 21 closed seats much of the time, not all
05:49:12 22 of the time but much of the time. And
05:49:16 23 it also shows you something about
05:49:17 24 responsiveness, which is a word that
05:49:20 25 we've heard used by multiple experts.

05:49:21 1 Responsiveness has to do with how when
05:49:21 2 electoral conditions change, does the
05:49:21 3 representational outcome go with it.
05:49:28 4 So if the kind of sea level rises and
05:49:29 5 falls with respect to voter
05:49:32 6 preferences, you'd like to see the
05:49:33 7 outcomes change, too. They shouldn't
05:49:35 8 be locked in. They should be able to
05:49:39 9 change.

05:49:40 10 Q. And can we go to the figure on
05:49:42 11 the next page of that initial report
05:49:44 12 please, page 16? And what does this
05:49:52 13 show? It looks like a similar set of
05:49:52 14 graphs.

05:49:53 15 A. It's the identical concept now
05:49:54 16 for the House map, HB-2146, the Draw
05:49:55 17 of the Lines, Citizens plan and the
05:49:57 18 Governor's plan across the same
05:50:00 19 dataset of statewide elections since
05:50:02 20 2014. And what I really think it
05:50:06 21 shows you is that the House map
05:50:10 22 behaves very much like the 2011
05:50:13 23 enacted plan in consist --- in missing
05:50:13 24 the bullseye, in consistently
05:50:20 25 converting close elections to heavy

05:50:24 1 Republican representational
05:50:25 2 advantages.

05:50:25 3 By contrast, the Citizens plan
05:50:27 4 does cross over that center point
05:50:29 5 right where you'd hope, right at the
05:50:32 6 bullseye, and the Governor's plan does
05:50:34 7 an excellent job of --- you know, if
05:50:38 8 we're playing paint ball, it's does an
05:50:40 9 excellent job of hitting that target.

05:50:40 10 Q. And just at the risk of beating
05:50:43 11 a dead horse, Citizens plan is Draw
05:50:43 12 the Lines?

05:50:46 13 A. Yes, that's the Draw the Lines
05:50:48 14 competition derived.

05:50:48 15 Q. Now, each of these dots here
05:50:51 16 represents the results of a different
05:50:51 17 actual election under these different
05:50:54 18 maps.

05:50:54 19 Correct?

05:50:55 20 A. Yes, that's right.

05:50:55 21 Q. Now I think we have heard
05:50:57 22 testimony this morning or we've seen
05:50:57 23 in some of the other expert reports
05:50:59 24 for experts who have not yet testified
05:51:00 25 that not all the experts did this

05:51:02 1 analysis on an individual election
05:51:03 2 basis. Some of them averaged
05:51:05 3 elections.
05:51:06 4 Is that right?
05:51:07 5 A. Yes, that's right. I think
05:51:08 6 you'll see that some of the analyses
05:51:12 7 before the Court they don't look at
05:51:13 8 the elections one at a time, and so
05:51:15 9 they're not looking at the fact that
05:51:18 10 there were these razor-thin, you know,
05:51:21 11 presidential and senate races or as,
05:51:21 12 you know, the Governor's race in a few
05:51:26 13 instances was a lot less close, this
05:51:26 14 is showing you something about change
05:51:29 15 over time. And it's showing you
05:51:30 16 something about different kinds of
05:51:32 17 offices being elected. When you
05:51:34 18 average those into a single election
05:51:34 19 index, you're losing all that
05:51:41 20 information about durability, about
05:51:42 21 responsiveness. You're effectively
05:51:44 22 taking all these points that you see
05:51:47 23 here and just collapsing them. An
05:51:48 24 animation for you not disclosed to the
05:51:50 25 other parties. But you're taking all

05:51:51 1 these points and you're collapsing
05:51:53 2 them to a single data point. And
05:52:00 3 you're systematically losing
05:52:01 4 information when you do that, and it
05:52:04 5 can be extremely misleading.

05:52:04 6 Q. And the information that is
05:52:05 7 represented in these pictures and that
05:52:07 8 could have been represented for the
05:52:09 9 other maps as well, can you
05:52:10 10 reconstruct this picture from the
05:52:10 11 information in any of the other expert
05:52:13 12 reports?

05:52:14 13 A. Some of the expert reports
05:52:16 14 provide you enough detail to see the
05:52:18 15 results election by election. Others,
05:52:21 16 and in particular, if I understand
05:52:23 17 right, I have --- I have made a great
05:52:24 18 effort to review all of the expert
05:52:27 19 materials in the time that was
05:52:29 20 available. And from my review, it's
05:52:31 21 my understanding in particular that
05:52:33 22 Doctor Barber's reports do not. And
05:52:34 23 so when I was looking --- you know, I
05:52:36 24 think all the experts will look at
05:52:39 25 each other's materials and will try to

05:52:41 1 find spot checks and make sure we
05:52:43 2 agree on things. For instance, I
05:52:45 3 noticed that in one of Doctor DeFord's
05:52:48 4 reports he says why are there only
05:52:49 5 11 points in these plots when there
05:52:52 6 are 12 elections. And that's because
05:52:54 7 it turns out that each of these three
05:52:55 8 plans has two points exactly on top of
05:52:59 9 each other, but good observation. And
05:53:00 10 that's exactly how you want experts to
05:53:00 11 be thinking about each other's work.

05:53:03 12 I will note that it was much
05:53:06 13 harder to audit and spot---check some
05:53:08 14 of Doctor Barber's findings because
05:53:10 15 there's so much averaging happening.
05:53:11 16 But in the instances where I was able
05:53:13 17 to, I found some clear errors of
05:53:16 18 calculation.

05:53:19 19 Q. And does that matter in terms
05:53:20 20 of, you know, the accuracy of a
05:53:25 21 partisan fairness analysis?

05:53:25 22 A. If your partisan fairness
05:53:25 23 analysis amounts to averaging and
05:53:26 24 you're systemically off by one seat
05:53:28 25 out of 17, yes, I would call that

05:53:30 1 substantial.

05:53:31 2 Q. Okay.

05:53:31 3 Can we pull up page four, Table 3, of
05:53:31 4 your response report, please? And I'm
05:53:42 5 going to ask, Professor Duchin, did
05:53:42 6 you use any other methods to analyze
05:53:46 7 the partisan fairness of the 13 maps?

05:53:54 8 A. I did. I used quite a few. So
05:53:54 9 such a standard technique that it
05:53:54 10 barely needs a name, and I think it's
05:53:54 11 an excellent one. However, there are
05:54:05 12 also metrics. There are metrics for
05:54:06 13 everything. And I think for these I
05:54:12 14 really spend a lot of time thinking
05:54:14 15 about these metrics and what they
05:54:14 16 mean. I'm intimately familiar with
05:54:16 17 them and how to calculate them and
05:54:18 18 what they do and don't tell you. And
05:54:20 19 in this case I think they help give us
05:54:22 20 a picture of the partisan fairness
05:54:25 21 landscape.

05:54:26 22 So I've highlighted efficiency
05:54:29 23 gap, which we've already heard about,
05:54:31 24 the mean-median score, which we
05:54:33 25 already heard about, partisan bias,

05:54:33 1 which is another symmetry measure that
05:54:33 2 we may have already heard about, and
05:54:33 3 one that we have not yet heard about
05:54:33 4 called the AGIA metric.

05:54:40 5 I'll be super brief. The AGIA
05:54:43 6 metric basically says I'm going to
05:54:44 7 compare the performance in districts
05:54:49 8 to the performance in another
05:54:50 9 geographical subdivision that isn't
05:54:53 10 gerrymandered, namely counties. So it
05:54:53 11 compares district performance to
05:54:57 12 county performance and tries to
05:54:57 13 control for the unequal populations in
05:54:59 14 the counties. It's one of several
05:55:01 15 kinds of metrics like that.

05:55:09 16 There's another one in the
05:55:09 17 literature co-authored by Drs. Rodden
05:55:09 18 and DeFord that uses a similar idea
05:55:12 19 that you should compare districts to
05:55:13 20 just the metric neighborhoods. Are
05:55:16 21 you like your neighbors? Is your
05:55:18 22 district like your neighborhood? I
05:55:19 23 think that's a very interesting metric
05:55:21 24 and I would have concluded it if I had
05:55:24 25 it coded at hand. The AGIA metric is

05:55:28 1 a little bit in the same direction.

05:55:31 2 Q. So bottom line, what does this

05:55:33 3 --- what does this table show?

05:55:33 4 A. Well, you're seeing a lot of

05:55:34 5 numbers here, and so I've tried to

05:55:36 6 color code it to be helpful. And

05:55:37 7 again, I haven't cherry picked the

05:55:39 8 elections at all, so this is across

05:55:41 9 all of the elections.

05:55:42 10 It's worth noting, though,

05:55:44 11 since I just critiqued averaging the

05:55:46 12 elections, performing the scores one

05:55:49 13 at a time and then averaging the

05:55:51 14 scores is not the same as averaging

05:55:52 15 the elections, and I think it gives

05:55:55 16 you a much better picture of the

05:55:57 17 situation.

05:55:58 18 So the color coding here is the

05:56:02 19 palist when the scores are closest to

05:56:02 20 zero, which is where you want to be in

05:56:04 21 all four cases. The darker reds are

05:56:09 22 more Republican favoring. The darker

05:56:11 23 blues are more Democratic favoring on

05:56:12 24 these scores.

05:56:12 25 Q. And what does this show you

05:56:14 1 about the relative partisan fairness
05:56:20 2 of the various maps at issue?

05:56:20 3 A. I think one thing that stands
05:56:22 4 out is that the Governor's plan is
05:56:23 5 excellent across the board, that in
05:56:25 6 all four of these metrics it gives
05:56:28 7 scores that are either the closest or
05:56:31 8 nearly the closest to zero.

05:56:32 9 Q. And do any of the other experts
05:56:34 10 dispute any of these numbers?

05:56:35 11 A. Not as far as I could tell.
05:56:38 12 It's not totally clear to me the way
05:56:40 13 all the experts are doing their
05:56:42 14 calculations or whether they're just
05:56:44 15 relying on prepackaged software to do
05:56:46 16 so, but I wasn't able to find any
05:56:50 17 contradictions to these numbers. I
05:56:54 18 think they're not in dispute.

05:56:54 19 Q. So I think we've sort of
05:56:56 20 already covered this, but this does
05:56:58 21 look like a bill wall of numbers. You
05:57:01 22 know, at the end of the day, what does
05:57:03 23 it actually mean?

05:57:04 24 A. Right. Walls of numbers can be
05:57:06 25 tough. You heard the phrase

05:57:08 1 multi-objective optimization before.
05:57:11 2 And that's a very mathy way of saying
05:57:13 3 you have multiple things and maybe
05:57:15 4 some things are better at one and some
05:57:17 5 things are better at another. So how
05:57:19 6 should we compare across multiple
05:57:21 7 scores?

05:57:21 8 Well, in mathematical data
05:57:27 9 science we have this concept called
05:57:29 10 the Pareto Frontier, which I think is
05:57:31 11 discussed perhaps in some of the
05:57:33 12 reports. And that's the idea of
05:57:34 13 asking which plans are --- dominate
05:57:37 14 others. So you say a plan dominates
05:57:40 15 another if it's better or equal on all
05:57:43 16 the scores. And what you see here if
05:57:47 17 you do an analysis, if you do a
05:57:49 18 comparison of the plans, in that way
05:57:51 19 is that there are three plans, the
05:57:52 20 Governor's plan, the Carter plan and
21 House Democratic Caucus. None of
22 those dominate the others. They're
23 each best in some of the scores. So
24 they're in what you might call the
25 trade-off zone. But the Governor's

1 plan dominates every other plan in the
05:58:11 2 grid in that mathematical sense. I
05:58:11 3 know that sounds a little aggressive,
05:58:11 4 but in that mathematical sense of
05:58:12 5 being superior in all the scores.
05:58:14 6 Q. Now, we've talked about an
05:58:16 7 overlay method that you employed. Did
05:58:19 8 you use any other methods to evaluate
05:58:21 9 the partisan fairness of the various
05:58:23 10 maps?
05:58:23 11 A. So this constitutes a method.
05:58:26 12 And I would clarify that on that
05:58:31 13 Pareto Frontier, there's still ways of
05:58:32 14 sort of preferring one plan to the
05:58:34 15 other. The Governor's plan is the
05:58:35 16 only one that dominates all of the
05:58:37 17 others. So in that sense it does
05:58:41 18 stand out if you want to use these
05:58:43 19 metrics. You know, because I really
05:58:45 20 think it's important --- as we heard,
05:58:46 21 I believe, just a moment ago it's
05:58:49 22 important not to cherry pick and just
05:58:52 23 try to make things look the best for
05:58:55 24 you. And so I'd say this kind of
05:58:57 25 analysis certainly would shift a

05:58:59 1 little if you used a larger set of
05:58:59 2 elections or smaller set of elections.
05:59:03 3 But the advantages here of the
05:59:03 4 Governor's plan are fairly substantial
05:59:05 5 and I don't think --- it might not be
05:59:09 6 literally be Pareto dominant, Pareto
05:59:11 7 optimal for a different set of
05:59:12 8 elections, but I think this shows that
05:59:14 9 it would be in a very strong position
05:59:19 10 under any reasonable way of
05:59:21 11 calculating these scores.

05:59:21 12 Q. We talked about at least, you
05:59:23 13 know, a couple of different methods,
05:59:24 14 maybe more. We've heard also
05:59:26 15 reference today to something called an
05:59:27 16 ensemble method. Are you aware of
05:59:29 17 what that is and did you employ that
05:59:31 18 in your analysis here?

05:59:32 19 A. Absolutely. So yes, the
05:59:33 20 ensemble method broadly is the use of
05:59:40 21 algorithmic techniques to generate
05:59:40 22 alternative plans. And I'm a
05:59:44 23 practitioner. I think maybe my
05:59:48 24 research group is one of the leading
05:59:48 25 groups in developing methods for

05:59:51 1 ensemble analysis.

05:59:51 2 Q. And how did you employ that
05:59:53 3 method here?

05:59:54 4 A. So as I mentioned earlier, I
05:59:55 5 created a comparison set of 100,000
05:59:59 6 alternative plans. And I didn't put a
06:00:03 7 great deal of detail about that into
06:00:05 8 these reports, but I'm happy to answer
06:00:07 9 questions.

06:00:07 10 Q. Can we call up opening report
06:00:10 11 pages 18 and 19, Figures 7 and 8,
06:00:14 12 please?

06:00:14 13 A. Thank you. Yeah, if I could
06:00:15 14 just say very briefly these plans were
06:00:18 15 made with a leading method of plan
06:00:22 16 generation that enforces contiguity
06:00:26 17 that has a strong preference for
06:00:29 18 compactness, that enforces the
06:00:31 19 threshold of population balance and
06:00:34 20 that aims to keeps counties and
06:00:40 21 municipalities whole. So those are
06:00:41 22 all taken into account in the creation
06:00:42 23 of these comparison plans.

06:00:42 24 Q. And how many different randomly
06:00:44 25 generated plans did you work with

06:00:46 1 here?

06:00:46 2 A. So this is 100,000, which I did
06:00:49 3 check and deemed to be enough to get
06:00:51 4 stable results. It's not hard these
06:00:54 5 days, we --- our leading
06:00:56 6 implementations can get to millions or
06:01:02 7 billions if you want them, but they
06:01:03 8 won't be more informative than what
06:01:06 9 you see here.

06:01:06 10 Q. And did you then compare the
06:01:09 11 Governor's map and the other 12 maps
06:01:09 12 in this case with the ensemble to see
06:01:10 13 how the maps would perform across
06:01:11 14 recent elections?

06:01:12 15 A. I did. And I don't know how
06:01:14 16 easy it is to see here, but the kind
06:01:18 17 of violins that you're seeing in gray,
06:01:18 18 those are the --- thank you, those are
06:01:24 19 the values that you see in the 100,000
06:01:25 20 alternative plans. And in this case,
06:01:27 21 because it was the initial report, the
06:01:28 22 Governor's plan, the Citizen a/k/a
06:01:31 23 Draw the Lines plan, and the House
06:01:33 24 a/k/a HB-2146 are shown.

06:01:39 25 Q. And did you conclude anything

06:01:42 1 about the districting landscape of
06:01:45 2 Pennsylvania based on your ensemble
06:01:45 3 analysis?

06:01:46 4 A. I did. And I think this is
06:01:47 5 another point on which you will hear
06:01:51 6 broad expert agreement. The landscape
06:01:52 7 in Pennsylvania as a function of where
06:01:53 8 people live and how they vote in these
06:01:56 9 elections regarded serially or
06:02:00 10 together, the landscape is somewhat
06:02:03 11 tilted towards Republicans.

06:02:05 12 And you can --- this plot shows
06:02:06 13 you negative scores here indicate a
06:02:06 14 Republican advantage. And those
06:02:06 15 violins spend a lot of time below
06:02:18 16 zero, right. That's showing you that
06:02:18 17 if you draw blind, you will get a plan
06:02:23 18 with a significant --- often, not
06:02:23 19 always, you'll get a plan with a
06:02:24 20 significant Republican advantage.

06:02:25 21 And if you look the at red dots
06:02:27 22 you can see the story behind the House
06:02:30 23 map is that it was drawn without
06:02:33 24 partisan data. That's my
06:02:36 25 understanding. And you know, that's

06:02:37 1 supported by what you see here. It
06:02:40 2 performs a lot like a typical blind
06:02:40 3 plan.

06:02:41 4 On the other hand, if you look
06:02:42 5 at the purple dots you will see that
06:02:44 6 they tend to deviate, but they deviate
06:02:47 7 in a direction of fairness. I would
06:02:51 8 call up an analogy to compactness.
06:02:51 9 You know, I'd say that, you know,
06:02:56 10 there's a --- there's a frequent
06:02:57 11 conceptual mistake that people make
06:03:01 12 with ensemble analysis, and that
06:03:04 13 mistake is that typical is best.

06:03:05 14 If you were drawing plans and
06:03:07 15 you looked at a range of compactness
06:03:09 16 scores, you wouldn't want a typical
06:03:11 17 compactness score, you'd want a good
06:03:13 18 one. And the same principal is
06:03:13 19 operative here.

06:03:17 20 And if we can switch to another
06:03:19 21 one of these plots just to see. Some
06:03:20 22 of these scores are more chunky and
06:03:23 23 some very in bigger jumps, but we can
06:03:25 24 see, for instance, the partisan bias,
06:03:29 25 which is the last ---.

06:03:29 1 Q. The bottom right?

06:03:30 2 A. Thanks. You know, that line at
06:03:31 3 zero is showing you ideal fairness by
06:03:37 4 the likes of this one metric. And you
06:03:39 5 can see that the Governor's plan in
06:03:42 6 purple is sometimes above and
06:03:42 7 sometimes below zero, but that it's
06:03:44 8 performing very well at trying to hit
06:03:47 9 that fairness benchmark while the red
06:03:50 10 dots of the House map are often quite
06:03:54 11 far.

06:03:54 12 Q. And we heard reference in some
06:03:54 13 of the earlier testimony to the
06:03:57 14 concept of human geography. I've also
06:03:57 15 heard the term political geography. I
06:03:59 16 want to ask you, does the political or
06:04:01 17 human geography of Pennsylvania
06:04:03 18 prevent the selection of a map that
06:04:08 19 treats Democratic and Republican
06:04:09 20 voters fairly and evenhandedly?

06:04:09 21 A. It manifestly doesn't prevent
06:04:13 22 you from drawing a fair map. And I
06:04:14 23 would just, again, briefly contrast
06:04:16 24 this to another situation that I've
06:04:18 25 published about. I've looked at ---

06:04:22 1 in an article in the Election Law
06:04:26 2 Journal in 2019 I looked at the
06:04:28 3 political geography in my home state
06:04:31 4 in Massachusetts. And in
06:04:33 5 Massachusetts I observed that even
06:04:34 6 though in Senate and Presidential
06:04:36 7 races, there's a 2 to 1 preference for
06:04:41 8 Democratic candidates. So you'd think
06:04:42 9 that with a third of the votes,
06:04:42 10 Republicans could get a third of the
06:04:43 11 congressional seats.

06:04:44 12 And what we showed in that
06:04:45 13 analysis is that they're actually
06:04:47 14 locked out. And that's not a function
06:04:49 15 of gerrymandering. It's a function of
06:04:53 16 the geography of where people live.
06:04:53 17 Republicans are just spread out too
06:04:59 18 evenly across Massachusetts to ever be
06:05:00 19 the majority of the district. And
06:05:00 20 that was true --- we looked at a full
06:05:02 21 ten years of elections and found that
06:05:04 22 lockout effect to be present.

06:05:06 23 We even looked at what would
06:05:08 24 happen if you let yourself just
06:05:10 25 sacrifice the traditional principles

06:05:10 1 to various extents. We even looked at
06:05:10 2 what would happen if you dropped
06:05:10 3 contiguity. So now you allow your
06:05:17 4 maps to be in many little pieces, and
06:05:18 5 we found that you still cannot draw a
06:05:18 6 Republican district in Massachusetts.

06:05:22 7 That is not the case in
06:05:24 8 Pennsylvania. You can draw a fairer
06:05:26 9 districts in Pennsylvania. You can do
06:05:28 10 so at no cost at all to the
06:05:30 11 traditional principles.

06:05:32 12 Q. That's what I was going to ask
06:05:34 13 you. I mean, you're saying it's
06:05:34 14 possible to draw fair districts, but
06:05:34 15 do you have to sacrifice the
06:05:38 16 traditional principles in the process?

06:05:38 17 A. Sorry, didn't mean to
06:05:40 18 anticipate the question, but yes,
06:05:43 19 that's where I'm going with this. I
06:05:45 20 studied in several ways whether
06:05:49 21 seeking fairness came at a cost. I
06:05:54 22 have other papers in which I've shown,
06:05:55 23 for instance, in Virginia that if you
06:05:57 24 highlight some principles, it comes at
06:06:01 25 a cost to others. That is not the

06:06:03 1 case here in Pennsylvania today. You
06:06:03 2 can get to better scores of fairness
06:06:05 3 with no cost at all in terms of
06:06:09 4 compactness, contiguity, political
06:06:10 5 subdivisions and so on.

06:06:12 6 Q. So I think some of the other
06:06:14 7 expert --- at least one other expert
06:06:14 8 report or brief has characterized the
06:06:16 9 Governor's map under an ensemble
06:06:20 10 analysis as an outlier. Is that ---
06:06:21 11 is that right or how would you assess
06:06:22 12 that?

06:06:22 13 A. Sometimes it's an outlier. And
06:06:24 14 you can see that here by being up, you
06:06:27 15 know, at an end of the violin. But
06:06:30 16 when it's an outlier, it's an outlier
06:06:32 17 in the direction of fairness. And I
06:06:34 18 would caution against the conceptual
06:06:38 19 mistake that typical is necessarily
06:06:42 20 fair. Blind is not necessarily fair.
06:06:47 21 Sometimes we have a benchmark such as
06:06:47 22 with compactness. You want to be more
06:06:47 23 compact. And I think with fairness,
06:06:56 24 you want to be more fair.

06:06:56 25 Q. Can we look at page four,

06:06:58 1 Table 3, of your response report, the
06:06:59 2 bottom ensemble line here included,
06:06:59 3 which I don't think we had that bottom
06:06:59 4 line before. And can you summarize
06:06:59 5 your overall conclusions on the
06:06:59 6 Governor's map versus the other maps
06:07:11 7 you analyzed?

06:07:11 8 A. Sure. Absolutely. What you
06:07:13 9 see here on the bottom is I took those
06:07:15 10 100,000 blind maps and I scored those
06:07:18 11 for fairness. And you see how those
06:07:20 12 are medium to bright red? That is
06:07:22 13 another indication that if you draw
06:07:25 14 blind you will not stumble on a fair
06:07:28 15 map, you have to seek a fair map. You
06:07:30 16 have to take that among --- you take
06:07:32 17 that sort of into consideration.
06:07:34 18 Now, like Professor DeFord, whom you
06:07:39 19 heard from before --- I did not draw
06:07:41 20 this plan, I just assessed it, but I
06:07:44 21 assess it to remediate this tilt of
06:07:46 22 the landscape at no cost to the
06:07:50 23 fundamental principles that gave us
06:07:52 24 our floor for ensuring no vote
06:07:57 25 dilution in Pennsylvania.

06:07:58 1 Q. Is it fair to say you can have
06:07:58 2 your traditional redistricting
06:08:00 3 principles and also have fairness at
06:08:02 4 least in Pennsylvania?

06:08:02 5 A. That's right. And once you're
06:08:04 6 in a zone of excellence with the
06:08:05 7 traditional principles, I see it as,
06:08:09 8 in my understanding, in my reading of
06:08:09 9 the League of Woman Voters Supreme
06:08:16 10 Court Decision from 2018, the Court
06:08:16 11 anticipated this and said in the
06:08:18 12 future it may be possible to draw
06:08:20 13 plans that are better, that are more
06:08:22 14 ideal, districts that are more ideal,
06:08:25 15 to harness technology to do better.
06:08:26 16 And I would say that this is just such
06:08:28 17 an example where the Governor's plan
06:08:30 18 upholds excellent neutral criteria and
06:08:34 19 just does better when it comes to
06:08:38 20 partisan fairness.

06:08:40 21 Q. Thank you. I want to ask you a
06:08:41 22 bit about the other expert testimony
06:08:43 23 reports that have been entered in this
06:08:44 24 case. First of all, have you been
06:08:46 25 able to read the other expert reports

06:08:46 1 in this case? I know it's been a
06:08:47 2 condensed timeline.

06:08:47 3 A. The word read might be
06:08:49 4 overstated, but I have been able to
06:08:51 5 look through and try to assimilate
06:08:54 6 everything in the other expert
06:08:55 7 reports.

06:08:55 8 Q. And do they generally reach
06:08:58 9 conclusions about whether blind
06:09:01 10 redistricting is the only option?

06:09:05 11 A. About whether blind
06:09:06 12 redistricting is the only option? I'm
06:09:08 13 not sure I saw that exactly, but I did
06:09:10 14 see comments in other reports to the
06:09:15 15 effect that we're bound by the
06:09:17 16 properties --- by the properties of a
06:09:20 17 blind process.

06:09:22 18 Q. And do you agree with that?

06:09:23 19 A. I don't. I think that it ---
06:09:27 20 again, it's an example of this idea
06:09:30 21 that I've called in some of my
06:09:31 22 publications the tyranny of the
06:09:33 23 median. It's just a mistake to think
06:09:37 24 that's what at the top of the hill
06:09:37 25 must be best. Sometimes you want to

06:09:39 1 be an outlier and you want to be an
06:09:41 2 outlier in the direction of better
06:09:43 3 scores and better upholding the
06:09:45 4 principles.

06:09:46 5 Q. I'd like to ask you some
06:09:47 6 questions about some discreet points
06:09:49 7 in the other expert reports. I think
06:09:52 8 we heard Doctor Rodden talk about a
06:09:54 9 table that was showing a razor's edge
06:09:59 10 analysis. Do you remember seeing that
06:10:00 11 with elections that were very close
06:10:03 12 percentage-wise to 50 percent or
06:10:06 13 within 2 percent or so. Do you
06:10:06 14 remember that?

06:10:07 15 A. Sure. I don't suppose it's
06:10:08 16 possible to bring that up.

06:10:09 17 Q. I don't know. Can we show
06:10:11 18 that?

06:10:11 19 A. That's okay. I do remember the
06:10:13 20 table.

06:10:14 21 Q. Okay.

06:10:15 22 Did you --- did you agree with
06:10:16 23 that analysis? Do you have any
06:10:17 24 opinions to offer on that analysis?

06:10:19 25 A. Well, while saying that I hold

06:10:21 1 Doctor Rodden in the very highest
06:10:24 2 regard, I do think that it is --- it's
06:10:26 3 making that averaging mistake to call
06:10:28 4 those razor's edge or close districts.
06:10:33 5 I would --- I would call to mind ---
06:10:34 6 again, let's think about the example
06:10:40 7 of Massachusetts, where you have
06:10:40 8 Presidential and Senate elections that
06:10:46 9 are heavily Democratic. We really
06:10:46 10 love our Republican Governors in
06:10:47 11 Massachusetts, and so you could
06:10:48 12 imagine taking an average of two
06:10:50 13 elections that are very blue, two that
06:10:54 14 are very red, and what that gives you
06:10:55 15 is a kind of purple stew that doesn't
06:10:59 16 resemble any election that ever
06:11:00 17 actually occurred. And so I do think
06:11:01 18 it would be a mistake to call that
06:11:04 19 competitive close coin flip or razor's
06:11:10 20 edge. It's just an average over
06:11:13 21 things that may never have been close.
06:11:17 22 Q. Okay. I understand.
06:11:17 23 Now, Doctor Barber, who is the
06:11:19 24 expert who submitted a House --- a
06:11:21 25 report for the House Republicans, he

06:11:22 1 relies on an ensemble analysis as
06:11:25 2 well?

06:11:25 3 Is that right?

06:11:26 4 A. Yes.

06:11:26 5 Q. And do you have any opinions
06:11:27 6 about his ensemble analysis?

06:11:35 7 A. Well, there's --- there's not a
06:11:36 8 great deal of information in here
06:11:37 9 about how it was done. But from what
06:11:39 10 I understand about how it was done, it
06:11:41 11 uses, in fact, a graph algorithm that
06:11:46 12 was developed by my research group but
06:11:49 13 in a manner that has not been peer
06:11:52 14 reviewed. So I would flag that as an
06:11:55 15 observation.

06:11:55 16 But really I think more
06:11:57 17 saliently I'm just not sure of his
06:11:59 18 handling of election data. And in a
06:12:00 19 few cases where I was able to check an
06:12:02 20 outcome, I think he may be
06:12:05 21 systematically off by a seat. And
06:12:08 22 when he's reporting his averages and
06:12:08 23 making a big difference about 9/8
06:12:08 24 versus 8/9, being off by a seat can
06:12:14 25 really matter.

06:12:14 1 Q. And what about his general
06:12:15 2 approach to the concept of partisan
06:12:18 3 fairness, do you have any opinions on
06:12:20 4 that?

06:12:21 5 A. It is squarely in the top of
06:12:23 6 the hill camp, making what I have just
06:12:25 7 called the conceptual mistake that the
06:12:31 8 properties of the middle of an
06:12:32 9 ensemble are necessarily and
06:12:32 10 normatively desirable.

06:12:32 11 ATTORNEY WIYGUL:

06:12:38 12 Can we pull up
06:12:39 13 page seven of Doctor Barber's report,
06:12:42 14 the paragraph starting with as a
06:12:43 15 result? Thank you.

06:12:43 16 BY ATTORNEY WIYGUL:

06:12:43 17 Q. So Professor Duchin, I want to
06:12:43 18 show you this paragraph and call your
06:12:43 19 attention to a few things that Doctor
06:12:55 20 Barber's rebuttal report says here.
06:12:55 21 He criticizes you for explicitly
06:12:59 22 considering partisanship in the
06:13:02 23 creation of districts. He says that
06:13:02 24 the previous decade shows us that
06:13:06 25 partisan preferences can be dynamic,

06:13:11 1 and then he exhorts the Court to let
06:13:11 2 the chips fall where they may.

06:13:11 3 Do you see that?

06:13:11 4 A. Great.

06:13:11 5 Q. What's your reaction to that?

06:13:13 6 A. No, this is great because it
06:13:14 7 has a lot all in the same paragraph
06:13:16 8 that I think is worth thinking about
06:13:18 9 together. So explicitly considering
06:13:24 10 partisanship in the creation of
06:13:27 11 districts, so first of all, again
06:13:27 12 again agreeing with a comment by
06:13:30 13 Doctor DeFord, that's not an accurate
06:13:32 14 description of the ensemble method.
06:13:32 15 Often you use a neutral ensemble that
06:13:36 16 doesn't look at partisan data at all
06:13:36 17 and then you just study the partisan
06:13:39 18 properties of the maps.

06:13:40 19 So however, for a process that
06:13:45 20 does consider partisanship in the
06:13:49 21 creation of districts, I think that
06:13:49 22 that can be a perfectly reasonable way
06:13:49 23 to achieve partisan fairness. An
06:13:54 24 analogy would be if you would like a
06:13:56 25 districting plan that doesn't split

06:13:59 1 counties, no one would propose that
06:13:59 2 you shouldn't know where the counties
06:13:59 3 are. If you want to do well at
06:14:07 4 something, it helps to have the data.
06:14:07 5 Having said that, you can also create,
06:14:11 6 as my ensembles did create, many
06:14:11 7 thousands, tens of thousands of
06:14:16 8 examples that do well on partisan
06:14:16 9 fairness but were made with no
06:14:18 10 partisan data.

06:14:19 11 Next, the previous decade shows
06:14:20 12 us that partisan preferences can be
06:14:22 13 dynamic. Yes, it does. And that's
06:14:24 14 why it's such a good idea to consider
06:14:28 15 the elections serially and not blend
06:14:29 16 them all together into a single stew.
06:14:30 17 So I think my approach does capture
06:14:32 18 the range of electoral preferences and
06:14:32 19 behavior that we've seen in
06:14:32 20 Pennsylvania in the recent cycle.

06:14:32 21 And this is a great place
06:14:46 22 perhaps to close. As you said, he
06:14:46 23 exhorts the Court to let the chips
06:14:48 24 fall where they may. And I would just
06:14:49 25 say there's no reason to do that when

06:14:54 1 you can do better, that we've got
06:14:55 2 techniques now that let you create
06:14:59 3 maps that do well by the likes of the
06:15:02 4 traditional principles and improve on
06:15:02 5 the properties of blind plans.

06:15:04 6 And so I'm not sure why we
06:15:07 7 should be bound to the pattern of
06:15:09 8 falling chips when we can create a
06:15:12 9 configuration that literally by the
06:15:15 10 likes of what the Court has called for
06:15:17 11 the Supreme Court has called for us to
06:15:19 12 consider. Why let the chips fall
06:15:19 13 where they may when we can do better?

06:15:25 14 Q. And in your view is the
06:15:26 15 Governor's plan among the few plans
06:15:29 16 before the Court that does do better?

06:15:30 17 A. It is. And in fact, as you'll
06:15:32 18 see in my report, if you take the
06:15:35 19 first tier of plans in the traditional
06:15:38 20 principles and you intersect them with
06:15:40 21 that Pareto Frontier and the partisan
06:15:43 22 fairness, I didn't know this would
06:15:45 23 happen in advance, but it turns out
06:15:48 24 there's only one map in both sets, and
06:15:51 25 that's the Governor's plan.

06:15:51 1 Q. Thank you, Professor Duchin. I
06:15:52 2 have no further questions.

06:15:53 3 JUDGE MCCULLOUGH:

06:15:53 4 All right. Thank you,
06:15:53 5 Counsel.

06:15:55 6 Now, we will allow
06:15:56 7 Petitioners Carter Counsel to begin
06:16:18 8 Cross.

06:16:18 9 ATTORNEY POSIMATO:

06:16:19 10 Good afternoon, Your
11 Honor.

12 JUDGE MCCULLOUGH:

13 Good afternoon.

14 ATTORNEY POSIMATO:

15 Joe Posimato on behalf
16 of the Carter Petitioners.

17 JUDGE MCCULLOUGH:

18 Team tagging each other.

19 Okay.

20 ---

21 CROSS EXAMINATION

22 ---

23 BY ATTORNEY POSIMATO:

06:16:23 24 Q. Good afternoon, Doctor Rodden.

06:16:23 25 A. Hi.

06:16:23 1 Q. Doctor Duchin. I'm sorry.

06:16:23 2 A. That's okay.

06:16:24 3 Q. Doctor Duchin, you produced two

06:16:26 4 reports in this proceeding.

06:16:27 5 Correct?

06:16:27 6 A. Yes.

06:16:28 7 Q. And the first was filed on

06:16:30 8 January 24th, 2022?

06:16:31 9 A. That sounds right, Monday.

06:16:33 10 Q. Monday. It's been a long week.

06:16:37 11 A. Wow.

06:16:40 12 Q. And the second filed January

06:16:41 13 26th, 2022?

06:16:41 14 A. Yesterday.

06:16:41 15 Q. Yes. So I'm going to focus

06:16:43 16 mostly on your second report start.

06:16:45 17 In your second report you state that

06:16:47 18 all plans are contiguous.

06:16:51 19 Right?

06:16:51 20 A. Yes.

06:16:51 21 Q. And that includes the Carter

06:16:53 22 plan?

06:16:53 23 A. It does.

06:16:53 24 Q. And in your second report that

06:16:56 25 all plans are closely population

06:16:58 1 balanced.

06:16:59 2 Right?

06:17:00 3 A. Right.

06:17:01 4 Q. In fact you testified earlier

06:17:03 5 on Direct?

06:17:04 6 A. I did.

06:17:04 7 Q. And that includes the Carter

06:17:06 8 plan?

06:17:07 9 A. It does.

06:17:08 10 Q. Because all the plans comply

06:17:08 11 with these criteria, including the

06:17:08 12 Carter plan, you focus your second

06:17:11 13 report on the criteria of compactness

06:17:13 14 and county and municipality splits.

06:17:16 15 Correct?

06:17:16 16 A. Right.

06:17:17 17 Q. And you state in your report

06:17:19 18 that you evaluate the plans,

06:17:23 19 compliance with these criteria on an

06:17:25 20 excellent standard?

06:17:26 21 A. That's right.

06:17:29 22 Q. Is there an objective metric

06:17:31 23 for measuring a plan's compliance with

06:17:33 24 traditional redistricting criteria?

06:17:37 25 A. I think part of the challenge

06:17:41 1 is that there are so many.

06:17:42 2 Q. And so is there an objective
06:17:42 3 measure you'd say or ---?

06:17:48 4 A. Am I right that you're asking
06:17:48 5 if all the metrics can be combined
06:17:50 6 into a single one?

06:17:51 7 Q. No. I'm asking whether under
06:17:52 8 any criterion, whether --- you know,
06:17:54 9 today let's take subdivision splits.
06:17:56 10 Is there an objective measure to
06:17:57 11 determine whether a map plan complies
06:17:59 12 with traditional criterion of respect
06:18:02 13 for subdivision splits?

06:18:04 14 A. Yes. And I promise I'm not
06:18:04 15 combative when I say there's one, but
06:18:09 16 there are a few different ways of
06:18:12 17 measuring that, but it is objective.

06:18:14 18 Q. Okay.

06:18:15 19 But compliance --- I understand
06:18:15 20 that there's an objective measure, but
06:18:16 21 is there an objective way to say that
06:18:16 22 one plan's, you know, take, you know,
06:18:16 23 five splits, another plan six splits,
06:18:16 24 follow on one side of a line or the
06:18:25 25 other side of a line, some objective

06:18:26 1 measure?

06:18:27 2 A. I think I understand now.

06:18:28 3 You're asking is there an objective
06:18:31 4 threshold.

06:18:31 5 Is that right?

06:18:31 6 Q. That's right.

06:18:33 7 A. Okay. Yes. No.

06:18:33 8 I think that here you can ---
06:18:34 9 you have to look at a plan compared to
06:18:36 10 alternatives. And then typically
06:18:38 11 there's no great bright line
06:18:40 12 threshold. I think that's what you're
06:18:42 13 asking.

06:18:42 14 Q. That's right. Thank you.

06:18:49 15 In fact, you state in your second
06:18:49 16 report that redistricting is not a
06:18:49 17 literal optimization problem.

06:18:49 18 Correct?

06:18:51 19 A. Yes I believe that strongly.

06:18:52 20 Q. And you also state that there
06:18:54 21 is no standard or universal way to
06:18:56 22 optimize universal factors at once?

06:19:00 23 A. That's right.

06:19:02 24 Q. And so is it fair to say that
06:19:04 25 complying with traditional or at least